3-26-2021

# Two new species of palm-leaf skeletonizers (Lepidoptera: Pterolonchidae: *Homaledra* Busck)

James E. Hayden
*Florida Department of Agriculture and Consumer Services*, james.hayden@fdacs.gov

A journal of world insect systematics

# INSECTA MUNDI

0859

# Two new species of palm-leaf skeletonizers (Lepidoptera: Pterolonchidae: *Homaledra* Busck)

James E. Hayden

Florida Department of Agriculture and Consumer Services
Division of Plant Industry
1911 SW 34th Street
Gainesville, FL 32608 USA

Date of issue: March 26, 2021

Center for Systematic Entomology, Inc., Gainesville, FL

**Hayden JE. 2021.** Two new species of palm-leaf skeletonizers (Lepidoptera: Pterolonchidae: *Homaledra* Busck). Insecta Mundi 0859: 1–24.

Published on March 26, 2021 by
**Center for Systematic Entomology, Inc.**
P.O. Box 141874
Gainesville, FL 32614-1874 USA
http://centerforsystematicentomology.org/

**Insecta Mundi** is a journal primarily devoted to insect systematics, but articles can be published on any non-marine arthropod. Topics considered for publication include systematics, taxonomy, nomenclature, checklists, faunal works, and natural history. Insecta Mundi will not consider works in the applied sciences (i.e. medical entomology, pest control research, etc.), and no longer publishes book reviews or editorials. Insecta Mundi publishes original research or discoveries in an inexpensive and timely manner, distributing them free via open access on the internet on the date of publication.

Insecta Mundi is referenced or abstracted by several sources, including the Zoological Record and CAB Abstracts. Insecta Mundi is published irregularly throughout the year, with completed manuscripts assigned an individual number. Manuscripts must be peer reviewed prior to submission, after which they are reviewed by the editorial board to ensure quality. One author of each submitted manuscript must be a current member of the Center for Systematic Entomology.

Guidelines and requirements for the preparation of manuscripts are available on the Insecta Mundi website at http://centerforsystematicentomology.org/insectamundi/



**Printed copies (ISSN 0749-6737) annually deposited in libraries**

Florida Department of Agriculture and Consumer Services, Gainesville, FL, USA
The Natural History Museum, London, UK
National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
Zoological Institute of Russian Academy of Sciences, Saint-Petersburg, Russia

**Electronic copies (Online ISSN 1942-1354) in PDF format**

Archived digitally by Portico
Florida Virtual Campus: http://purl.fcla.edu/fcla/insectamundi
University of Nebraska-Lincoln, Digital Commons: http://digitalcommons.unl.edu/insectamundi/
Goethe-Universität, Frankfurt am Main: http://nbn-resolving.de/urn/resolver.pl?urn:nbn:de:hebis:30:3-135240

0859: 1–24 **INSECTA MUNDI** 2021

# Two new species of palm-leaf skeletonizers (Lepidoptera: Pterolonchidae: *Homaledra* Busck)

James E. Hayden

Florida Department of Agriculture and Consumer Services
Division of Plant Industry
1911 SW 34th Street
Gainesville, FL 32608 USA
james.hayden@fdacs.gov

**Abstract.** Two species of palm-leaf skeletonizers (Lepidoptera: Pterolonchidae: *Homaledra* Busck) that are invasive in Florida, USA are newly described. *Homaledra howardi* **new species** is described from Florida and the Dominican Republic. *Homaledra knudsoni* **new species** is described from Florida, southern Texas, and Mexico. A lectotype is designated for *Homaledra sabalella* (Chambers). The three are diagnosed and compared with other congeners, and *Homaledra* is compared with other Pterolonchidae. The larvae of the three common species feed on epidermis of palm foliage, causing significant damage.

**Key words.** Arecaceae, Caribbean Region, Florida, frass, Gulf of Mexico Region, introduced species.

**Resumen.** Se describen dos especies de palomillas de hojas de palma (Lepidoptera: Pterolonchidae: *Homaledra* Busck) que son invasivas en Florida, EE. UU. *Homaledra howardi* **nueva especie** se describe de Florida y la República Dominicana. *Homaledra knudsoni* **nueva especie** se describe de Florida, el sur de Texas y México. Se designa un lectotipo para *Homaledra sabalella* (Chambers). Las tres se diagnostican y comparan con otros congéneres, y *Homaledra* se compara con otros Pterolonchidae. Las larvas de las tres especies comunes se alimentan de la epidermis del follaje de las palmeras, causando daños importantes.

**Palabras claves.** Arecaceae, Cuenca del Caribe, especies introducidas, excremento, Golfo de México.

**ZooBank registration.** urn:lsid:zoobank.org:pub:B6DA8972-8EAE-465F-B4E2-D38B299267B7

## Introduction

*Homaledra* Busck (Lepidoptera: Pterolonchidae) comprises five previously described species of gelechioid moths that are distributed in the Neotropics and southern Nearctic. The known larvae of most of the species feed on foliage of palms (Arecaceae) (Howard et al. 2001). *Homaledra sabalella* (Chambers), the palm-leaf skeletonizer, is a common pest of palms in the southeastern United States (Creighton 1937). The present publication provides descriptions for two congeners that have invaded the State of Florida in recent decades. Descriptions are presently needed because the larvae cause significant damage across wide areas in the state and because *Homaledra* species are capable of further invasive movement (Penrose 2001).

Busck (1900) proposed *Homaledra* in Elachistidae and included two Nearctic species: *H. heptathalama* Busck and *H. sabalella* (Chambers), transferring the latter from *Laverna* Curtis. Hodges (1997) transferred two Neotropical species, *H. citraula* (Meyrick) and *H. crocoxysta* (Meyrick), from *Pammeces* Zeller, and Baldizzone et al. (2006) transferred *H. octagonella* (Walsingham) from *Coleophora* Hübner. There are other undescribed species in Central America and the Caribbean region, some of which have been misidentified as *H. sabalella* or those described herein. Over time, the genus has been placed in at least seven gelechioid families, with most of the recent treatments classifying it in Coleophoridae or Batrachedridae (Hodges 1983, 1998). *Homaledra* displays a mix of structural characters that do not clearly indicate what family it belongs to. It has recently been transferred to Pterolonchidae based on morphological and molecular evidence drawn from *H. sabalella* and from one of the undescribed species (Heikkilä et al. 2014). *Homaledra* has many of the characters possessed by pterolonchids (see diagnostic discussion below).

Of the two species that are newly described below, the first was observed in Florida in the mid-1990s by a researcher, Prof. F.W. Howard (University of Florida), who witnessed conspicuous damage to foliage of coconut palms and other palm species (Howard 1996; Howard and Abreu 2007). For several years, it was unclear whether the "coconut palm leaf skeletonizer" was a distinct species or merely a "biotype" of *H. sabalella* that had

undergone a host shift to prefer coconut (Howard and Abreu 2007). Examination and dissection of specimens indicate that it is a distinct species both from *H. sabalella* and from other undescribed species in Puerto Rico. Some lots of preserved larvae in the Florida State Collection of Arthropods show that, in fact, it was present in Florida as early as 1975.

A second species has infested palms in Florida for more than a decade. The first suggestion that another new species was present was made by James T. Vargo, who collected specimens at light at Kissimmee Prairie in 2015 and 2016 at a site next to infested cabbage palms. Recognizing differences in maculation from *H. sabalella*, he sent a photograph to the author, who agreed that it seemed distinct (email 5 April 2016). The next year, encouraged by Dr. Mark Metz (USDA Systematic Entomology Laboratory) to probe the distribution of the first species, the author reared pupae collected on *Sabal palmetto* (Walter) Lodd. in Gainesville. To much surprise, Vargo's species emerged. Subsequent collections revealed that the second species is very common in Gainesville and other counties in peninsular Florida, especially the northern half (Hayden 2019), but it has been misidentified as *H. sabalella*.

The most useful characters to differentiate the three species are the maculation of the palpi and forewings, the length of the antennae, the male sex scales on the first through third abdominal segments, the cornuti of the phallus, and the corpus bursae and signum in females. It is possible to identify adult moths to species from close-up photographs taken with a macro lens (White 2006). Larvae can be diagnosed by the number and relative size of the subventral setae on A3–A6, which vary interspecifically from three to five (rarely six). Mitochondrial COI (Folmer region, the "barcode" gene) differs by about 10% or more among the species.

Morphologically, *Homaledra* resembles the monotypic Old-World genera *Syringopais* Hering and *Houdinia* Hoare, Dugdale, and Watts. *Batrachedra* Herrich-Schäffer is also similar, and many species of that genus are sympatric with *Homaledra* species. Because the larvae of some *Batrachedra* species also feed on palms, adult batrachedrids are often collected together with *Homaledra* in traps set near palms.

## Materials and Methods

Institutional abbreviations are as follows:

**CDFA** California Department of Food and Agriculture (Sacramento, CA, USA)
**FLREC** University of Florida Fort Lauderdale Research and Education Center (Fort Lauderdale, FL, USA)
**FSCA** Florida State Collection of Arthropods (Gainesville, FL, USA)
**MGCL** McGuire Center for Lepidoptera, Florida Museum of Natural History (Gainesville, FL, USA)
**USNM** U.S. National Museum of Natural History (Washington, D.C., USA)

The type material and other specimens are deposited in the FSCA unless indicated.

Dissection followed Robinson (1976) by maceration in 10% aqueous KOH. Cuticular structures were stained with Chlorazol black, Eosin Y in 70% ethanol, or mercurochrome, sometimes with more than one stain to accentuate different structures, and slide-mounted in Euparal. Slide numbers refer to genitalic dissections unless wings or larvae are indicated; whole-body dissections were not made of adult moths. Morphological terms follow Hodges (1998), except that the forewing radial veins $R_2$–$R_5$ are $Rs_1$–$Rs_4$ (Kristensen 2003). Photographs of habitus, external characters, and some dissection slides were taken with an Auto-montage Pro 5.01 system (Synoptics Ltd.) including a JVC camera and Leica Z16APO lens. Helicon Focus version 6.7.1 Pro (Kozub et al. 2000) was used to stack images if necessary. Higher-magnification slide photographs were taken with a Leica DM6 B compound microscope, a DMC6200 camera, and Leica Application Suite X to process the stacked images. Images were edited and assembled with Adobe Photoshop Elements 11. Where the collection coordinates of specimens were not primarily available, the points were georeferenced with the street address. The distribution map was made with the online tool SimpleMappr (Shorthouse 2010).

COI barcoding was done by standard procedures (Hebert et al. 2004) by the FDACS-DPI Molecular Diagnostics Laboratory, and results were compared to sequences available on BOLD Systems (Ratnasingham and Hebert 2007, www.boldsystems.org). Where multiple specimens were collected of a species with gregarious larvae, a whole larva was submitted for DNA sequencing, and the other specimens were reared for identification. Where available, Barcode Index Numbers (BIN) (Ratnasingham and Hebert 2013) are indicated for taxa. Additional sequences were submitted to GenBank (Clark et al. 2016).

Moths were reared from larvae found on infested palm leaves. The cut leaves were placed in large Ziploc© bags (up to the 60 × 51 cm "Big Bags" size), which were sealed to prevent leaf desiccation and hung up on lines. The bags were inspected daily for eclosed moths, which were collected by hand, killed, and preserved or pinned. In the case of *H. sabalella*, colonies of larvae were kept following Cronin (2011). Strips of leaves of *Serenoa repens* (W. Bartram) Small were cut in 15 to 30 cm sections, paper-clipped together at both ends, and loaded with a small number of larvae. These sandwich-like sections were kept in gallon wide-mouth jars and inspected daily. As leaves were skeletonized, new sections were added to the outside of the sandwiches, and spent sections were carefully removed after larvae had moved to the fresh sections. Sealing the ends of leaf sections with paraffin (Creighton 1929) did not prevent them from drying out; only maintenance in airtight jars or bags prevented leaves from desiccating.

Host plants follow the Atlas of Florida Plants (Wunderlin et al. 2021). Hostplants are stated (Table 1) only for samples from which identifiable *Homaledra* specimens were collected and examined by the author. Host records repeated only from the literature must be viewed with skepticism because of the possibility of misidentification.

# Systematics

## *Homaledra* Busck, 1900

**Type species.** *Homaledra heptathalama* Busck 1900: 236, by original designation.

**Diagnostic comments.** The newly described species are placed in *Homaledra* Busck because they share numerous characters of adult and immature morphology with *H. sabalella* and *H. heptathalama*. Busck (1900) diagnosed *Homaledra* with external characters and venation in comparison to taxa known at the time. Examined specimens vary more in wing venation than his description indicates (see below), so his diagnosis is minimally useful. *Homaledra* is currently classified in Gelechioidea: Pterolonchidae Meyrick following the results of Heikkilä et al. (2014), so a proper diagnosis should be made in comparison to other genera in that family. However, that analysis did not include the type species *H. heptathalama*, which differs from the other species in a few morphological characters that are traditionally deemed significant at higher levels (see *Variation* below). Thus, the monophyly of *Homaledra* has not been tested by phylogenetic analysis. The data matrix of Heikkilä et al. (2014, their appendix 3) includes single terminals for most pterolonchid genera, so it would seem straightforward to draw the diagnosis from that. Unfortunately, the dataset includes a few erroneous scorings (L. Kaila, pers. comm. 2020 and pers. obs.) which would make such a diagnosis questionable. Examination of the characters scored by Heikkilä et al. (2014, appendix 2) finds that *H. heptathalama* and *H. sabalella* have the same states, except for the conditions (noted below) of the abdominal tergal spine fields, the larval submental pit, sclerotized rings around the SD1 setae, and the A9 SD1 seta.

*Homaledra* species, including *H. heptathalama* and the newly described ones, share the following characters. The male forewing retinaculum arises from Sc, not from a spur of Sc. The forewing CuP vein is present and tubular at the distal margin. The hind wing $M_1$ and $M_2$ veins are stalked, and the cell is open distally. Abdominal sternum 1–2 has venulae secundae close together, and apophyses are absent. The abdominal tergites have spiniform setae that are in continuous fields or divided in two subdorsal rows; these setae are concentrated on tergites 2–6, with a few on 1 and 7. The gnathos is absent. The transtilla is strongly arched dorsally, the ends arising from the dorsal articulation points of the valvae. A simple juxta is present that lacks lateral lobes. The valvae are simple, without costal or saccular processes or a fibula. The valvae are weakly articulated with the vinculum and are easy to spread apart in dissection and slide-mounting. The wall of the phallus has a narrow sclerite extended most of its length. In the larva, the V setae of T1–T3 are medioposterior of the coxae. The A1 SV group is bisetose. On A9, the D1, D2, and SD1 setae are not in a horizontal line, D1 being anterior of the D2-SD1 line. The female genitalia have one signum that is a round, spiniferous sclerite or a dense field of granules. The female S8 is not longer than other sterna. Adult females of *H. heptathalama* have not been observed.

*Homaledra* larvae key out to Stenomatinae in Carter (1998), couplet 68, with setae L1 and L2 on abdominal segment 9 close together. The SV formula is 2, 3, 2, 1, 1 on abdominal segments 1, 2, 7, 8 and 9. In *H. sabalella* and the species described below, the head has a submental pit (Fig. 44: sp), and the abdominal SD1 setae are not

surrounded by ringed sclerites. Larvae of *H. heptathalama* differ in some characters as noted below. The color is uniform pale pink or pale green during development, turning white in preservation (Fig. 39). Prepupal larvae develop bold, dark-pink longitudinal stripes (Fig. 38, 40); this is common to all the species, and no differences in the pattern of stripes was observed among them.

Variation in the genus is as follows. In the adult, a pecten on the antennal scape is present in *H. octagonella* and those described below but absent in *H. sabalella* and *H. heptathalama*. *Homaledra heptathalama* may have forewing $Rs_3$ and $Rs_4$ stalked (Fig. 37), in common with *H. sabalella* but contrary to Busck's description. Likewise, the two species described below show variation in venation. Most species have chaetae evenly distributed on the abdominal tergites (Fig. 11–13), but these are divided into two parallel longitudinal rows in *H. heptathalama* (Fig. 14) and divided on posterior tergites of *H. octagonella* (Fig. 15). In the larva, a submental pit is present in most species but absent in *H. heptathalama*. The SD1 seta of A9 varies from normally elongate and seta-like in *H. heptathalama*, rather reduced in the newly described species, and short, curved, and more hairlike in *H. sabalella*. Sclerotized rings around the SD1 setae of A1–A8 are present in *H. heptathalama* but absent in the other species. The SV setae of A3–A6 range from 3 to 5 (rarely 6).

Within Pterolonchidae, Heikkilä et al. (2014) found *Homaledra* to be related to *Syringopais*, which includes one species, *S. temperatella* (Lederer), in the Near and Middle East. The gnathos is absent in both genera. What Hodges (1998) may have mistaken for a gnathos is either the sclerotized dorsal edge of the tegumen or the dorsally arched transtilla. In contrast, *Batrachedra* species (Batrachedridae) possess a well-developed gnathos, lateral lobes of the juxta, and tergal spines always arranged in two narrow subdorsal rows. Most other pterolonchids possess a gnathos, but a gnathos is absent also in *Houdinia flexilissima* Hoare, Dugdale, and Watts, a New Zealand species (Hoare et al. 2006). *Homaledra* and *Syringopais* share valvae that are easily separable (Kemal and Koçak 2015), whereas most other Pterolonchidae have valvae that are relatively immobile and projected posteriad (Heikkilä et al. 2014). *Syringopais* shares some of these characters, such as 2 A1 SV setae and presence of a submental pit (Hodges 1998). *Houdinia* is described as having an elongate sclerite along the phallus (Hoare et al. 2006), which all *Homaledra* species share (Fig. 22: ps); a similar structure is known only in Blastobasidae among other gelechioids (M. Metz and D. Adamski, pers. comm. 2020).

Larvae of most *Homaledra* species feed on the epidermis of leaves of Arecaceae (Howard et al. 2001), except that *H. octagonella* feeds on lichens (Eiseman 2008). Table 1 presents the host plants on which larvae were collected and moths were reared for the present study. *Syringopais* larvae are major leafmining pests of wheat and barley, and they also mine in a wide range of herbaceous dicots (Yefremova et al. 2017). The larvae of *Houdinia flexilissima* mine the culms of *Sporadanthus ferrugineus* de Lange, Heenan and Clarkson (Restionaceae) (Hoare et al. 2006). As far as known, a preference for concealed feeding on monocots is unique within Pterolonchidae to *Homaledra*, *Syringopais*, and *Houdinia*, but whether it is a synapomorphy remains to be tested.

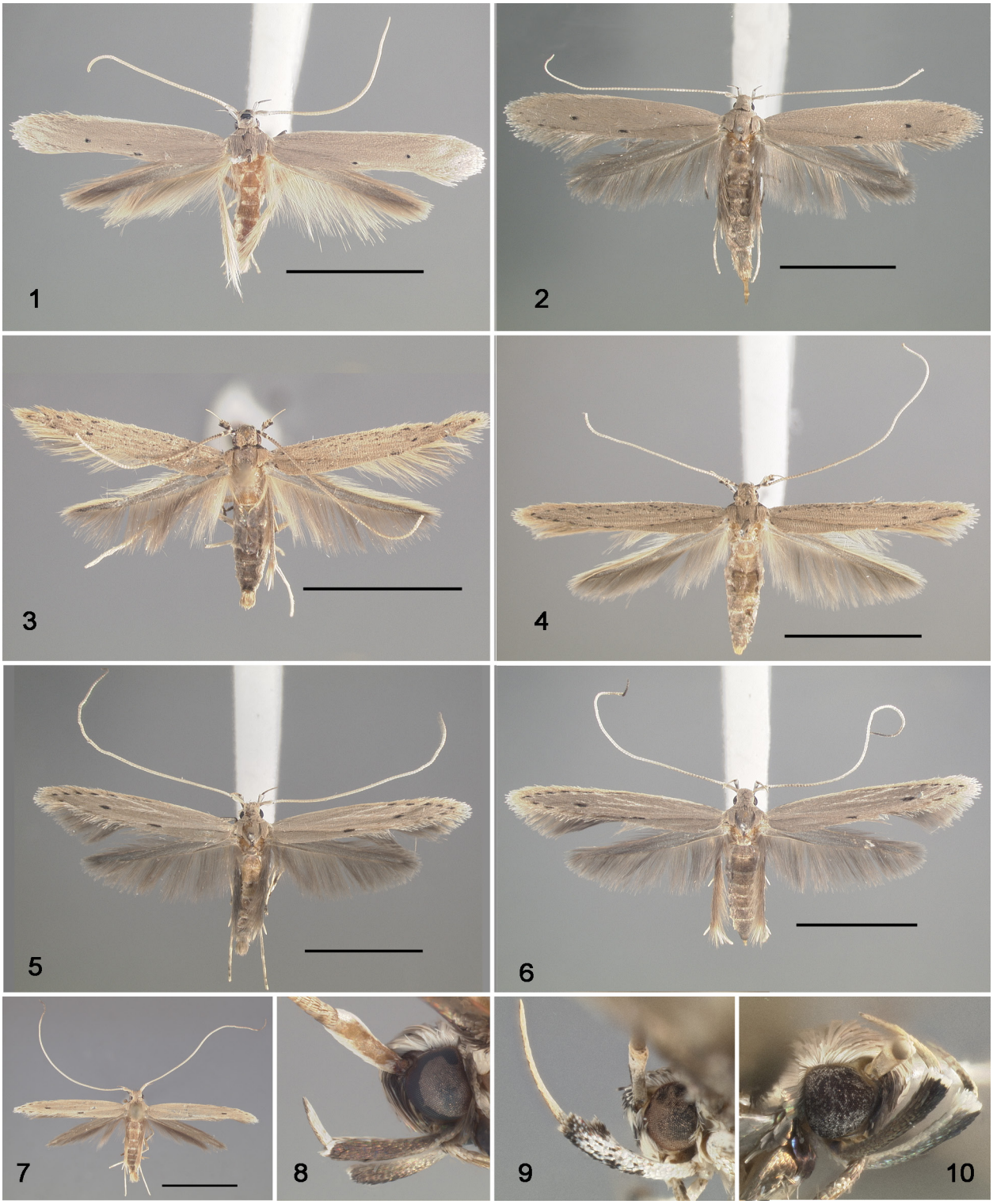
A careful morphological comparison and cladistic analysis of all *Homaledra* species together with *S. temperatella*, *Houdinia flexilissima*, and other Pterolonchidae should be done to delimit the genera. If there is any possibility of generic synonymy, *Homaledra* Busck, 1900 has priority over most pterolonchid genera except *Pterolonche* Zeller, 1847.

### *Homaledra sabalella* (Chambers, 1880)

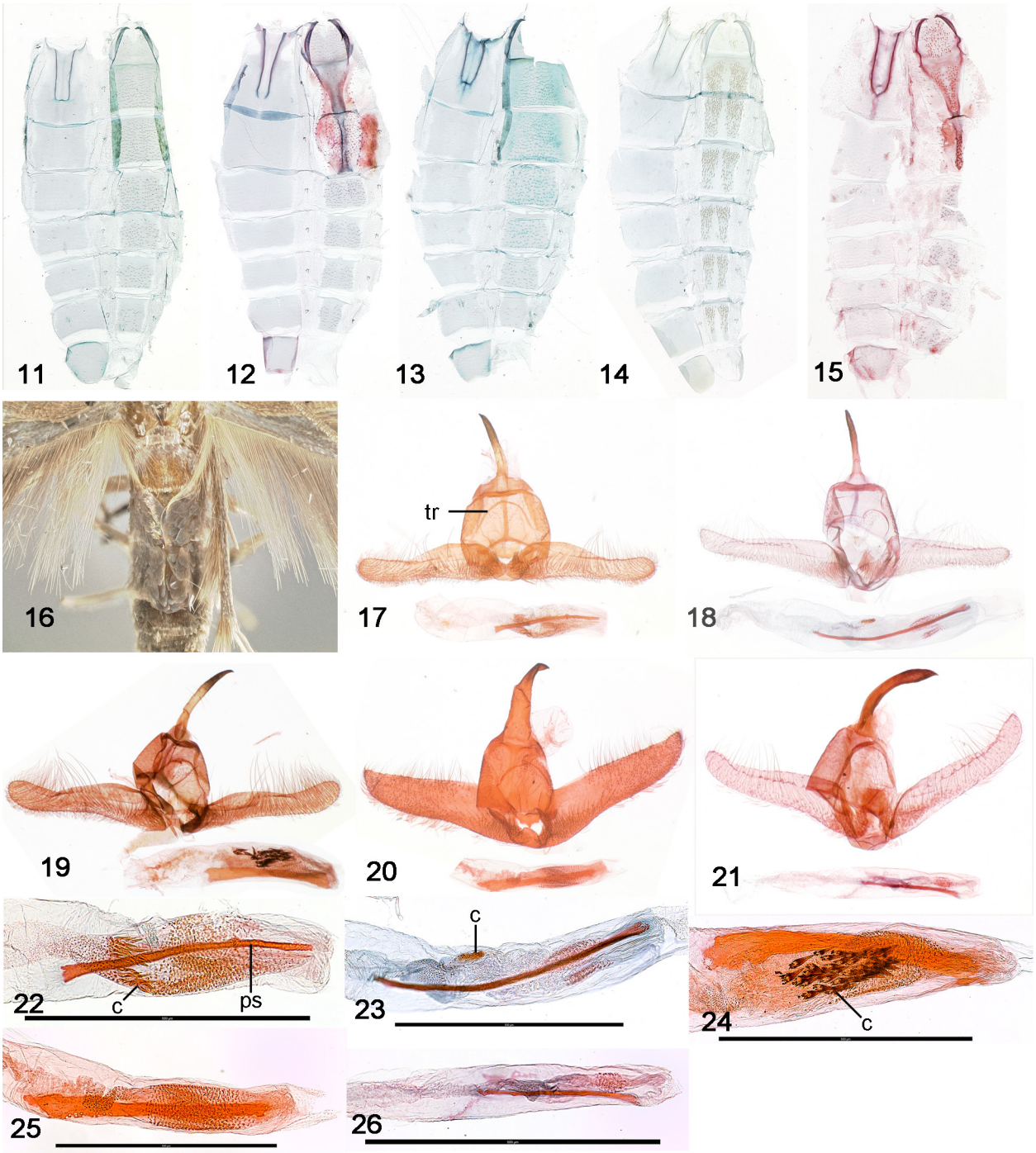
(Fig. 1, 2, 8, 11, 17, 22, 27–29, 34, 38, 41, 45, 50–52)

*Laverna sabalella* Chambers 1880: 185.
*Homaledra sabalella* (Chambers): Busck 1900: 238.

**Diagnosis.** *Adult.* In *H. sabalella*, the second segment of the labial palp is uniformly dark gray exteriorly, and the apical segment is about 1/2 to 3/5 the length of the second (Fig. 8). The antennae are shorter than the wings and lack a pecten. The wings are almost wholly beige, with black scales usually only in two spots at the end of the discal cell and along the anal fold near the margin (Fig. 1, 2). Fresh specimens have black scales along the termen. The hind wing lacks hair pencils. The forewing has $M_1$ strong and fully separate from $Rs_{2+3}$ (Fig. 34). $CuA_1$ and $CuA_2$ are both present in the forewing and the hind wing. The dorsal male abdomen of *H. sabalella* is not modified: all tergites are of even width, and scale tufts are absent (Fig. 11). In the male genitalia, the phallus has a broad ring of cornuti instead of a row (Fig. 22). The apex of the valva is more rounded (Fig. 17). In the female




**Figures 1–10.** Habitus and heads of *Homaledra* spp. **1)** *Homaledra sabalella* male (FL, Lake Co.). **2)** *H. sabalella* female (FL, Levy Co.). **3)** *H. howardi* holotype male (FL, Miami-Dade Co.). **4)** *H. howardi* female (FL, Miami-Dade Co.). **5)** *H. knudsoni* male (FL, Osceola Co.). **6)** *H. knudsoni* female (FL, Alachua Co.). **7)** *H. knudsoni* holotype male (TX, Cameron Co.). **8)** *H. sabalella* head in lateral aspect (FL, Lake Co.). **9)** *H. howardi* head (FL, Miami-Dade Co.). **10)** *H. knudsoni* head (FL, Alachua Co.). Scales = 5 mm.

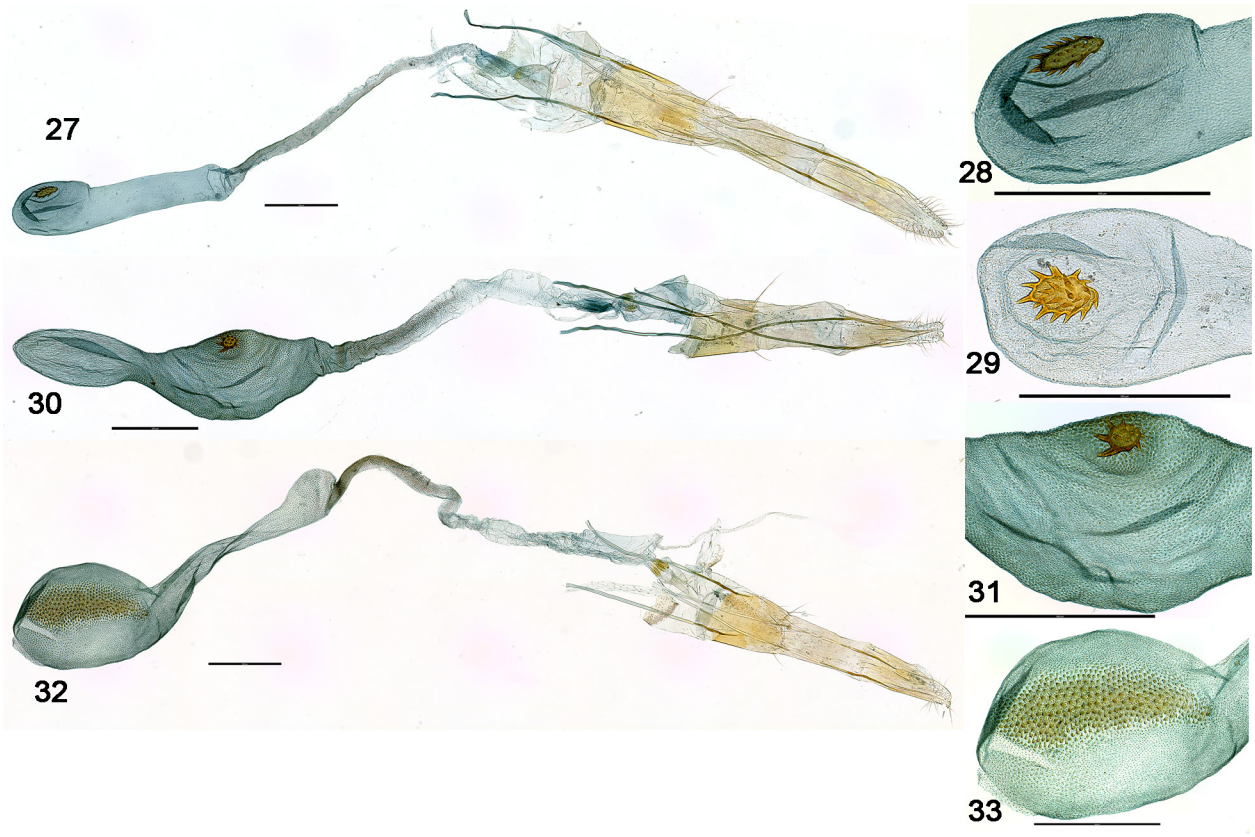



**Figures 11–26.** Male abdominal structures of *Homaledra* spp. 11–15, cuticle; 16, androconia of hind wings and tergites 2–3; 17–21, male genitalia and phalli; 22–26, cornuti (scales: 0.5 mm). Numbers refer to MGCL slides. **11)** *H. sabalella* (#4257). **12)** *H. howardi* (#3296). **13)** *H. knudsoni* (#4438). **14)** *H. heptathalama* (#4260). **15)** *H. octagonella* (#4542). **16)** *H. howardi* (FL, Miami-Dade Co.). **17)** *H. sabalella* (#4257). **18)** *H. howardi* (#3296). **19)** *H. knudsoni* (#4438). **20)** *H. heptathalama* (#4260). **21)** *H. octagonella* (#4542). **22)** *H. sabalella* (#4257). **23)** *H. howardi* (#3296). **24)** *H. knudsoni* (#4580). **25)** *H. heptathalama* (#4260). **26)** *H. octagonella* (#4542). c, cornuti; ps, phallus sclerite; tr, transtilla.

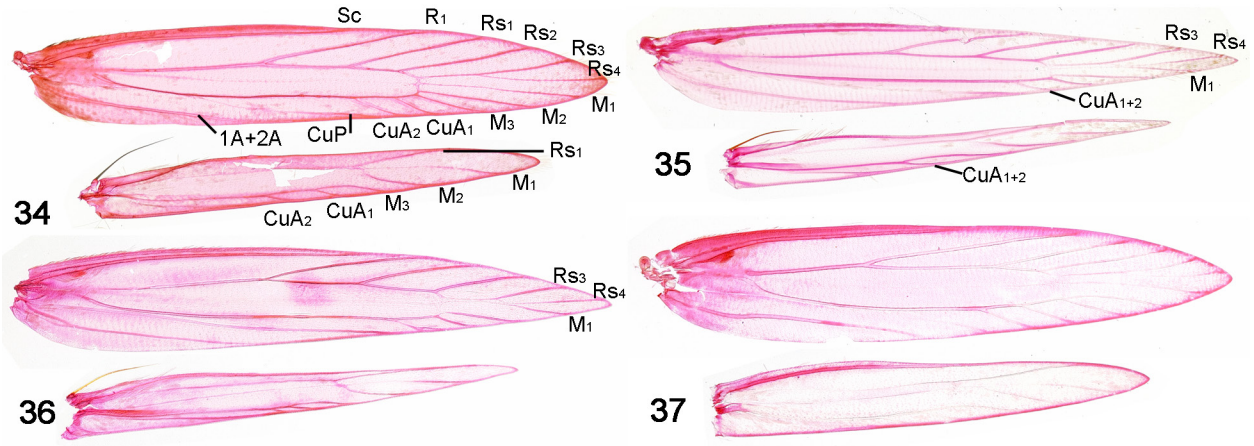
genitalia, the corpus bursae is pyriform, broadest anteriad (Fig. 27). The signum is located on the anterior apex of the corpus bursae, and its spines are of uniform size (Fig. 28, 29). *Larva* (Fig. 38). The SV group of A3–A6 is trisetose, without small extra setae (Fig. 41). *Pupa* (Fig. 45). The wings, antennae, and metathoracic legs are all extended to the middle of the 5th abdominal segment, and the antennae and legs are not longer than wings; the antennae are tangent on the 3rd segment.

**Material examined.** The lectotype of *Homaledra sabalella* in the USNM is hereby designated: ♀, label "No. 272 = 748P. *Laverna* n. sp. V.T. Chambers, Oct. 8/79" (USNM). Paralectotypes are as follows: 1♀: "No. 272. Iss. Feb. 25/80 | 778 | Laverna sabalella Cham. Type", abdomen in gelcap; 11 (sex not observed): No. 272, (2) Iss. March 13/80, (1) Iss. March 24/80, (1) Iss. Feb. 21/80, (2) Iss. Feb. 18/80, (2) Iss. March 1/80, (2) Iss. Feb. 25/80; (1) Iss. Feb. 26/80, (1) Iss. Jan. 31/80, USNM slide 146,319.

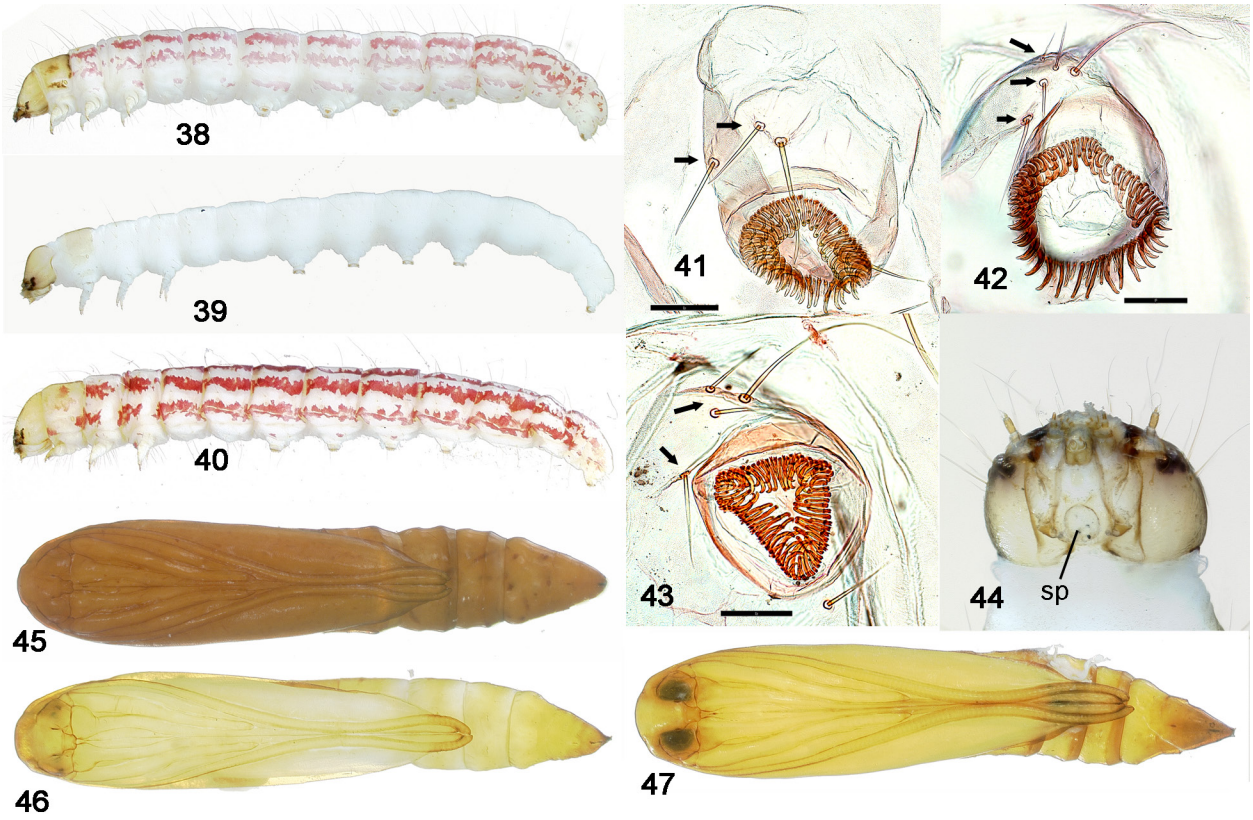
Specimens are in the FSCA and MGCL except as noted. **BAHAMAS:** 1♀: S. Andros Is., W. of The Bluff, 24.106939, −77.557659, 29-III-2014, J. Miller, M. Simon, R. Rozycki, D. Matthews, MGCL #233653, MGCL slide 4456. **USA: California: San Diego Co.:** 2♂, 1♀: San Diego, 6477 Neiman Ranch Rd., 32°58′26″N, 117°10′31″W, 24-I-2001, R. Garrison, ex *Phoenix canariensis*, *Homaledra sabalella* (Chambers) ♂, Det. R.W. Garrison 2001 (CDFA and FSCA); 1♂: Rancho Santa Fe, 25-I-2001, col: Jim Lawrence, ex: Canary Is. Palm, HOMALEDRA sabalella det: T.D. Eichlin, CDFA GENITALIA SLIDE #890 by S.A. Kinnnee; 1♀: same data, J.E. Hayden slide no. 6332 (CDFA); 1♀: same data, not dissected (FSCA); **Georgia: Chatham Co.:** 8♂, 1♀: Savanna, Bamboo Farms, 27-III-2003, Bromet and Ferris, on *Rhapidophyllum hystrix*, *Butia capitata*, *Livistona nitida*, and *Thrinax* sp.; **Florida: Alachua Co.:** 10 larvae: Alachua, 29.8800, −82.4896, 9-I-2020, *Butia capitata*, S. Hart; 3♂, 4♀: Gainesville, reared, 14-II-1947, 16-II-1947, 17-II-1947, 6-III-1947, 1-IV-1947, H.V. Weems Jr. (FSCA); 1♀: Gainesville, 16-I-1971, D.H.H., Palmetto leaf, MGCL slide 358; 1♂: same data, MGCL slide 4450; 1♂: Gainesville, Malaise trap, 19-IV-1976, W.H. Pierce, MGCL slide 3321 (wings); 1♂: Gainesville, on *Phoenix canariensis* [no date], H.L. Dozier, MGCL slide 4454; 1 larva: Gainesville, UF Campus, 30-V-1972, *Serenoa repens*, T.M. Neal; 10 larvae: Gainesville, 23-V-1978, *Phoenix reclinata* Jacq., C. Ort; 2 larvae: Newberry, 29.5640, −82.6378, 19-X-2017, *Sabal palmetto*, J. Hayden, J. Awad; **Baker Co.:** ~20 larvae: Glen St. Mary, 5-I-1960, *Butia capitata*, E.W. Holder Jr.; ~50 larvae: same data except *Sabal palmetto*; **Bay Co.:** 3 larvae: S. Fountain, 30.4359, −85.4219, 26-V-2019, *Serenoa repens*, P. Skelley, K. Schnepp; **Brevard Co.:** 1 larva: Merritt Island, 3880 N. Courtenay Pkwy., 24-VII-2019, *Phoenix reclinata*, D. Cermak; **Broward Co.:** 1♂, 2♀: FLREC, 5-IV-2002, *Phoenix canariensis*, D.H. Baquerizo, L125, L126, L165; 4 larvae: Parkland, 8200 NW 82nd Terr., 5-III-2020, *Phoenix* sp., S. Webb; **Collier Co.:** 1♂: Collier-Seminole St. Pk., 25-I-1986, Dow, MGCL slide 357; 4 larvae: Naples, 25-IV-1984, *Washingtonia robusta*, R. Buchholz; 5 larvae: Naples, 4-V-1994, *Sabal minor*, M. Brodie; 3 larvae: Naples, 220 Red Bird Lane, 26.0953, −81.6841, *Livistona chinensis*, 7-XII-2018, S. Krueger, E18-6379, MGCL slide 4998 (larval cuticles); 1♂: Naples, 2170 Logan Blvd N., 26.271453, −81.720689, Reared on *Phoenix* sp., 12-I-2018, S. Krueger, E18-0219, MGCL slide 4569; **Gilchrist Co.:** 1♂: Trenton, Bell Ridge Longleaf W.E.A., ex larva on *Serenoa repens,* 22-XI-2017, eclosed 19-XII-17, T. Greenwald, M.E. Flowers, MGCL slide 4547; 1♀: same data, ecl. 9-I-2018, T. Greenwald, M.E. Flowers, MGCL slide 5025 (wings); 1 larva: same data except 12-VIII-2018, J. Hayden, E18-4295, MGCL slide 4852 (larval cuticle); 6 preserved larvae: same data except 10-XII-2017; **Glades Co.:** 3 larvae: Ortona, 17-X-1982, *Sabal palmetto*, D. Akin; **Hardee Co:** 1 larva: Zolfo Springs, 2855 Kerlew Dr., 3-XII-2013, *Butia capitata*, S. Berryman, K. Clanton; **Hernando Co.:** 5 larvae: Brooksville, 3-VIII-1084, *Phoenix canariensis*, R. Dudley; 5 larvae: Ridge Manor, 13-III-1984, *Butia capitata*, R. Dudley; **Highlands Co.:** 1♂: Archbold Biol. Sta. 10 mi. S Lake Placid, Raised on *Serenoa repens,* 4-V-1975, J.B. Heppner #75E7, MGCL slide 3302; 1♀: same data, MGCL slide 3303, genitalia and wings; **Hillsborough Co.:** 1♀: Tampa, USF Ecology Area, 20-II-1990, L.C. Dow, MGCL slide 4459; 5 larvae: Tampa, 12505 N. Nebraska Ave., 8-II-2018, *Copernicia alba*, T. Streeter; **Lake Co.:** 1 larva: Howey Hills, 22-X-1980, *Cocos* sp., H. Morrison; **Lee Co.:** 2 larvae: Fort Myers, 11-I-1960, *Sabal minor*, H.W. Collins Jr.; **Levy Co.:** 1♀: Goethe St. For., Gasline Rd., 29.1608, −82.5984, MV/UVL, 11-III-2017, J. Hayden, MGCL slide 4445; **Manatee Co.:** 1♂: Oneco, 13-VI-1954, Paula Dillman, MGCL slide 339; 1♂: Terra Ceia, 7-III-1986, L.C. Dow, MGCL slide 4444; **Miami-Dade Co.:** 1♂, 1♀: Florida City, 15-IX-1991, W. Lee Adair Jr., MGCL slides 4443 (♀) and 4453 (♂); 9 larvae: Homestead, 24-IX-1993, *Phoenix* sp., J. Peña; 5 larvae: Key Biscayne, 20-V-1980, *Cocos nucifera*, W. James; 3 larvae: Lehigh, 15-V-1989, *Serenoa repens*, L. Maynard; ~20 larvae: Miami, 29-IV-1981, *Acoelorraphe wrightii*, L. Howerton; **Monroe Co.:** 1♂: Big Pine




**Figures 27–33.** *Homaledra* female genitalia, MGCL slide number given. **27)** *H. sabalella* (#4566). **28)** *H. sabalella*, detail of signum (#4566). **29)** *H. sabalella*, detail of signum (#3303). **30)** *H. howardi* (#4261). **31)** *H. howardi*, detail of signum (#4261). **32)** *H. knudsoni* (#4673). **33)** *H. knudsoni*, detail of signum (#4673). Scale bars = 500 μm.




**Figures 34–37.** *Homaledra* wings. MGCL slide number given. **34)** *H. sabalella* (#3321). **35)** *H. howardi* (#3335). **36)** *H. knudsoni* (#5005). **37)** *H. heptathalama* (#5029).




**Figures 38–47.** *Homaledra* immature stages. **38)** *H. sabalella*, larva. **39)** *H. howardi*, larva. **40)** *H. knudsoni*, larva. **41)** *H. sabalella*, A3 proleg with 3 SV setae. **42)** *H. howardi*, A4 proleg with 3 large and 2 small SV setae. **43)** *H. knudsoni*, A3 proleg with 4 SV setae. **44)** Ventral aspect of head of *H. howardi* showing submental pit (sp). **45)** *H. sabalella*, pupa. **46)** *H. howardi*, pupa. **47)** *H. knudsoni*, pupa. Scales = 100µm.

Key, 12-I-1988, J.B. Heppner, 1♂: same data, MGCL slide 4455 (FSCA); 1♀: Big Pine Key, vic. Watson Hammock, 25-XII-1987, L.C. Dow; 5 larvae: Key Largo, 18-III-1980, *Arecastrum romanzoffianum*, G. Anderson; 1♂: Key Vaca, Marathon, 30-VII-1997, L.C. Dow (MGCL); 3 pupae: Ramrod Key, on *Thrinax* sp., 15-I-2014, J. Farnum; **Orange Co.:** ~15 larvae: Pine Castle, 30-VII-1980, *Phoenix canariensis*, F. Ware; 6 larvae: Union Park, 30-XII-1947, scrub palmetto, O.D. Link; 4 larvae: Winter Garden, 13-II-1975, *Roystonea oleracea*, M.G. Howard Jr.; **Osceola Co.:** 1♂: Kenansville, Joe Overstreet Rd., Larvae on *Serenoa repens*, 15-XII-2017, ecl. 11-I-2018, T.S. Greenwald, M.E. Flowers, E18-155, MGCL slides 4565 (♂); 1♀: same data, MGCL slide 4566; 1♂: same data, MGCL slide 5026 (wings); 1 pupa: Three Lakes W.M.A. on *Serenoa repens*, 2-XI-2018, M.E. Flowers, T. Greenwald; **Palm Beach Co.:** 3 larvae: Delray Beach, 10-VII-1987, *Acoelorraphe wrightii*, S.T. Hoskin; 10 larvae: Delray Beach, 16668 Winners Circle, 26.4245, −80.2140, 17-VIII-2018, *Washingtonia robusta*, K. Harris, E18-4398; 3 larvae: Wellington, 16691 Rustic Rd., 22-X-2020, *Phoenix canariensis*, C. Parkes; **Pinellas Co.:** 3 larvae: Seminole, 24-VII-1958, *Phoenix canariensis*, R.E. Woodruff, C.E. Bingamon, R.W. Miller; 3 larvae: Seminole, 9-III-1971, *Acoelorraphe wrightii*, G.T. Williams; 4 larvae: St. Petersburg, 11-IX-1967, *Phoenix reclinata*, C.K. Hickman; 1 larva: St. Petersburg, 1-IV-1971, *Washingtonia filifera*, G.T. Williams; 3 larvae: same data except Tarpon Springs, 8-IV-1971; **Putnam Co.:** 1♂, 1♀: Welaka For. Cons. Sta. Site 7, live oak-longleaf pine woods. 28–31-VII-1986, J.B. Heppner, MGCL slides 4451 (♂), 4452 (♀); ~10 larvae: [no site], 18-X-1981, *Serenoa repens*, P. Wales; **Santa Rosa Co.:** 1♂: Blackwater River St. Pk. 7-10-VI-2000 J.B. Heppner, MGCL slide 4257; **Sarasota Co.:** 1 larva: Osprey, 8-I-1969, *Washingtonia robusta*, J.R. McFarlin, C.J. Bickner; **St. Johns Co.:** 1 larva: Saint Augustine, 8650 County Rd. 13 N., 2-I-2015, *Phoenix* sp., K. Hire, E15-53; **Sumter Co.:** 1♂: Bushnell, Victoria's Tiki Huts, reared on *Sabal palmetto*. 16-I-2014, eclosed 13-II-2014. J. Wylie, L.J. Buss. E17-4561, MGCL slide 4521; **Volusia Co.:** 5 larvae: Daytona Beach, VI-1959, *Phoenix* sp., G.W. Dekle; 3 larvae: New Smyrna

Beach, 28.9442, −81.1017, 6-II-2018, *Washingtonia robusta*, K. Coffey, E18-433; **Washington Co.:** 1♀: Rock Hill Prsv. Near Chipley, 30.73600, −85.48364, MV/UVL 28-IV-2017, J. Hayden, MGCL slide 4258. **North Carolina: Jones Co.:** 1♂: No. of Stella Hardwood Landing, Croatan For., 2-VIII-1997, hardwoods, UV trap, J. Bolling Sullivan. **Texas: Jasper Co.:** 2♂: Martin Dies St. Pk., 13-X-1985, E.C. Knudson, [one] MGCL slide 4457; 1♀: same data, 17-VIII-1985, MGCL slide 4458.

**Larval behavior.** Although all of the palm-feeding species of *Homaledra* in Florida make frass-covered tunnels with loose silk, larvae of *H. sabalella* additionally bind leaf sections together with dense webs of tough silk (Fig. 52). The larvae gregariously strip the epidermis of the entire section of a palm leaf, from one edge to the other, so the tunnels are rather like broad, covered promenades (Fig. 51). They often bind together adjacent leaf sections, like a sandwich. The leaf-tying behavior facilitates feeding on species of *Phoenix* L. (date palms), as the larvae tie together numerous narrow leaflets (Fig. 50). The two species described below were not observed producing leaf-binding silk nor making exceptionally broad frass tunnels. However, *H. sabalella* larvae may not invariably tie leaves, so one should not rule out *H. sabalella* when one observes only simple frass tubes. The behavior and colony-rearing methods were studied in depth by Creighton (1929) and summarized in Creighton (1937).

**Host plants.** *Acoelorraphe wrightii* (Griseb. and H. Wendl.) H. Wendl., *Butia capitata* (Mart.) Becc., *Cocos nucifera* L., *Cocos* sp., *Copernicia alba* Morong, *Phoenix canariensis* H. Wildpret, *Phoenix reclinata* Jacq., *Phoenix* sp., *Roystonea oleracea* (Jacq.) O.F. Cook, *Sabal minor* (Jacq.) Pers., *Sabal palmetto, Serenoa repens*, *Syagrus romanzoffianum* (Cham.) Glassman, *Thrinax* sp., *Washingtonia filifera* (Linden) H. Wendl., and *Washingtonia robusta* H. Wendl.

**Distribution.** Bahama Islands; U.S.A.: southern coastal plain, South Carolina through Florida to eastern Texas; introduced in southern California.

**Remarks.** The specimens of Chambers's type series do not vary in maculation, having no white lines on the forewings and no terminal black dashes.

*Homaledra sabalella* is confirmed to be the species that appeared in San Diego in 2000 (Penrose 2001). The fact that it infests *Phoenix* agrees with the observed behavior in its native range (Fig. 50). *Homaledra sabalella* is also the species studied by Cronin (2011) in Louisiana, as shown by photographs of voucher specimens sent to the author.

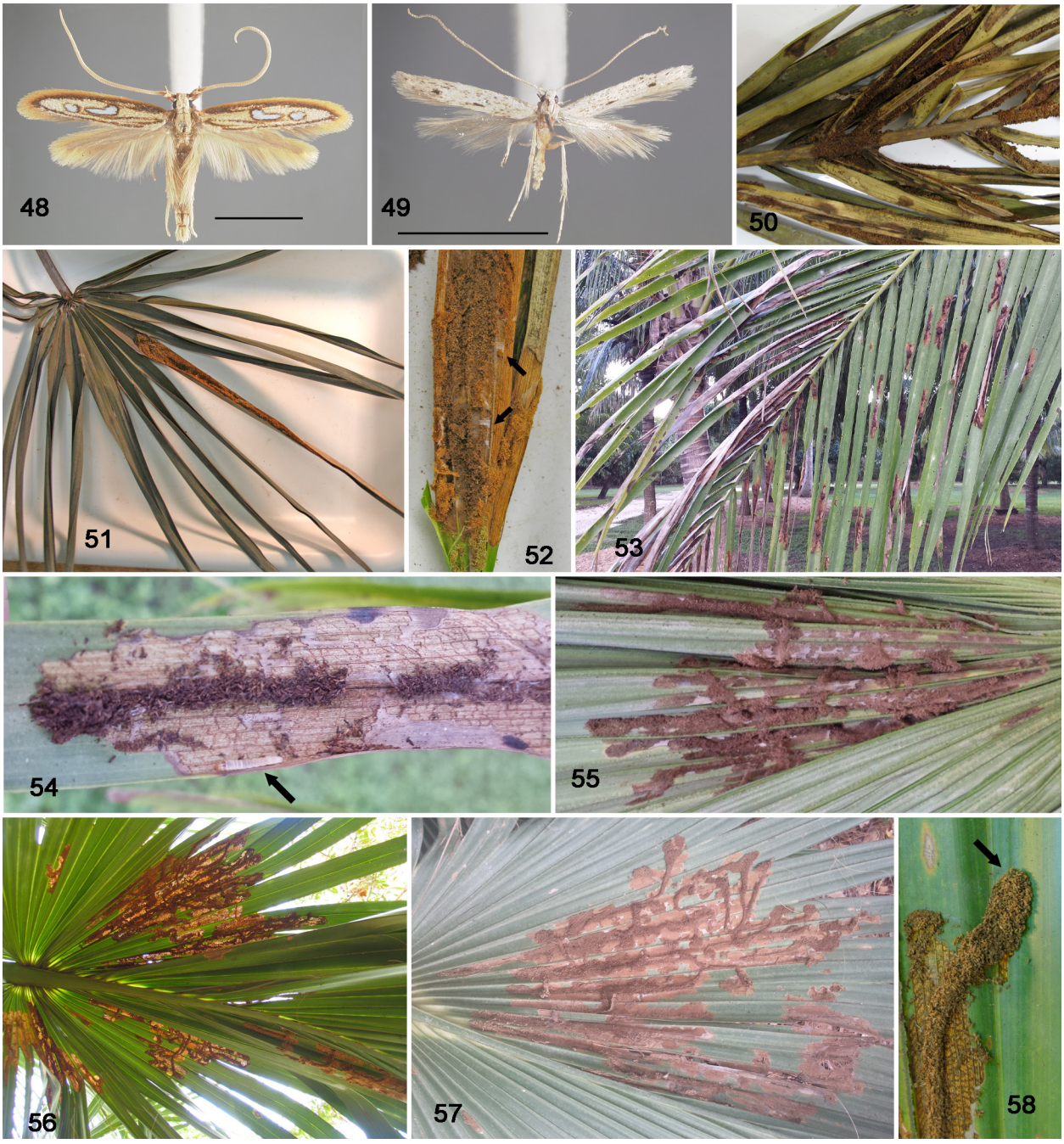
*Homaledra sabalella* is represented by the BIN (Barcode Index Number) BOLD:AAD4166 (DOI: https://doi.org/10.5883/BOLD:AAD4166).

### *Homaledra howardi* Hayden, new species

(Fig. 3, 4, 9, 12, 16, 18, 23, 30, 31, 35, 39, 42, 44, 46, 53–55, 59)

**Type material.** Holotype ♂: [white label] "USA, FL, M.-Dade Co. Miami 7821 SW 22 St. on *Livistona chinensis*. 29-VIII-2017 G. Gonzalez E17-3497 Eclosed 9–13 Sep. 2017", [blue label] "J.E. Hayden photo index 456" (FSCA).

Paratypes: **USA: Florida: Broward Co.:** 1♂: [no site], X-1999, F.W. Howard; 3♀, 1 undet. sex: BCC, 20-IX-2002, *Washingtonia robusta*, F.W. Howard, L347, L350, L351, L358; 1♂: same data except 17-IX-2002, L357; 1♀: same data except 17-IX-2002, L354, MGCL slide 5024 (wings); 1♂: FLREC, 29-VII-2002, *Cocos nucifera*, F.W. Howard, L357, slide MGCL 4634; 1♀: Ft. Laud., 27-VI-2002, *Corypha XFR Sabal*, F.W. Howard, L365; 3♀: FLREC, 17-II-2003, *Latania* sp., S. Ortiz, L637, L638, L641, [one] slide MGCL 4643; 1♀: same data except *Cocos nucifera*, L642; **Collier Co.:** 2♂, 1♀: Naples, 10040 Greenway Road, reared on *Bismarckia nobilis* leaves, 13-I-2016, S. Krueger, E16-577; 1♂: same data, MGCL slide 3296; 1♀: same data, MGCL slide 3297 (genitalia and wings); 1♂: Naples, 4410 32nd Ave. SW, reared on *Sabal palmetto*, 5 Dec. 2018, S. Krueger, E18-6380; 1♀: same data, slide MGCL 4997; **Miami-Dade Co.:** 2♂: Coral Gables, US 1 & Granada, reared on royal palm, 10-IV-2012, H. Mayer, E12-3258; 1♂: Miami, 10360 SW 118 St. on house wall, 10-IV-2015, O. Garcia, E15-1792, slide MGCL 2799; 1♂, 1♀: Palmetto Bay, 17525 SW 87 Ave., raised on fan palm, 14-X-2015, L. Bradshaw, E15-5869, slides MGCL 3099♂, 3102♀; Dade U.M., 24-II-2003, *Sabal palmetto*, Bromet & Ortiz, L644, L648, L649; 1♂: same data except *Thrinax* sp., L651 (USNM); 1♀: same data except *Thrinax* sp., L653 (FSCA); 1♂, 2♀: same data as holotype, [one] slide 4497♀ (1♂, 1♀: FSCA, 1♀: USNM); 1♂, 1♀: Miami, 17960 SW 232 St. on *Cocos nucifera*, 26-VII-2018, W. Mazuk, E18-4018; 1♂: Coral Gables, USDA ARS SHRS, 25.6429, −80.2946, suction trap, 11–18-IV-2016, S. Halbert, MGCL slide 4259 (wings); 1♂: same data except 22-II–1-III-2016, slide MGCL 3335 (genitalia and wings); 1♂: same data except 7–13-III-2017, H. Escobar, slide MGCL 4139; **Palm Beach Co.:**




**Figures 48–58.** Habitus of other *Homaledra* species and larval damage. **48)** *Homaledra heptathalama* male (FL, Levy Co., FSCA). **49)** *H. octagonella* male (FL, Putnam Co., FSCA). **50)** Damage of *H. sabalella* on date palm (*Phoenix* sp.) (FL, Collier Co.). **51)** Damage of *H. sabalella* on *Serenoa repens* (FL, Lake Co.), with broad frass tunnel. **52)** Damage of *H. sabalella* on *Serenoa repens* (FL, Levy Co.), dense leaf-tying silk indicated. **53)** Damage of *H. howardi* on *Cocos nucifera* (FL, Miami-Dade Co.). **54)** Detail of same with larva indicated. **55)** *H. howardi* on *Livistona chinensis*, showing damage on a broad-leaved palm (FL, Miami-Dade Co.). **56)** Damage of *H. knudsoni* on *Sabal palmetto* (FL, Alachua Co., Gainesville). **57)** Same (FL, Alachua Co., Micanopy). **58)** Active leading end of frass tunnel (indicated) of *H. knudsoni* (FL, Alachua Co., Gainesville). Scales = 5 mm.

1♂: West Palm Beach, X-1999, B. Turney, ex *Cocos nucifera*, slide JBH 2016; 1♀: West Palm Beach, 10-X-1999, B. Turney, slide MGCL 4261; 1♂, 1♀: West Palm Beach, 27-VI-2002, *Latania* sp., David H. Baquerizo, L368 (USNM); 1♀: same data except L369, MGCL slide 5023 (FSCA); 1♂: same data except on *Corypha umbraculifera*, L370. **County unknown:** 1♀: US 27, 5-III-2003, *Washingtonia robusta*, F.W. Howard, L655. **DOMINICAN REPUBLIC:** One slide of ♂ genitalia: "*Homaledra sabalella* Ch. on palm San Domingo W. Isd. [?] AB, XI-1928, USNM 146,320" (USNM).

**Other material examined** (imagines unless indicated, sex not examined for most). **USA: Florida: Broward Co.:** 1 larva: Parkland, 8055 NW 82nd Terrace, 26.3283, −80.2367, 1-II-2019, *Bismarckia nobilis*, S. Webb; 6 specimens: [no site], X-1999, F.W. Howard; 1♀: same data, slide MGCL 3388; 1: [no site], 23-IX-1999, B. Turney; 1: [no site], 10-X-1999, B. Turney; 2: Broward Community College, 27-X-1999, B. Turney; 2: [no site], 11-V-2001, *Livistona*, J. Lord, L85–86; 1: [no site], *Sabal palmetto*, 22-V-2001, J. Lord, L88; 1: same data except 3-VII-2001, L90; 3: same data except 18-VII-2001, L94, L99, L100; 10: [no site], 21-II-2002, *Cocos nucifera*, J. Lord, L61–65, L67, L68, L73, L77, L79; 4: FLREC, 9-III-2002, *Cocos nucifera*, J. Lord, L81–84; 3: same data except *Washingtonia robusta*, L116–118; 2: FLREC, 11-III-2002, *Sabal palmetto*, J. Lord, L119, L120; 7: FLREC, 27-III-2002, *Washingtonia robusta*, J. Lord and D.H. Baquerizo, L121–124, L235–237; 1: FLREC, 3-IV-2002, *Serenoa repens*, D.H. Baquerizo, L246; 3: FLREC, 16-IV-2002, *Sabal palmetto*, J. Lord, L239–241; 2: FLREC, 22-IV-2002, *Sabal palmetto*, D.H. Baquerizo, L244, L245; 175: FLREC, 23-IV-2002, *Cocos nucifera*, D.H. Baquerizo, L127–164, L166–196, L198–234, L276–333, L335–345; 2: FLREC, 7-V-2002, *Sabal palmetto*, D.H. Baquerizo, L242, L243; 3: same data except *Serenoa repens*, L247, L273, L274; 24: same data except *Latania* sp., L248–272; **Collier Co.:** 2 larvae: Naples, 10040 Greenway Road, 13-I-2016, *Bismarckia nobilis*, S. Krueger; 3 larvae: Naples, 4410 32nd Ave. SW, 5-XII-2018, *Sabal palmetto*, S. Krueger; **Miami-Dade Co.:** 32 specimens: Cutler/Coral Gables, USDA ARS SHRS, 25.6429, −80.2946, suction trap, S. Halbert, H. Escobar, J. Farnum, 20–27-IV-2015, 8–15-XII-2015, 11–18-IV-2016, 25-IV–2-V-2016, 2–9-V-2016, 27-VI–5-VII-2016, 5–11-VII-2016, 18–25-VII-2016, 16–22-VIII-2016; 19–27-XII-2016, 1–17-I-2017, 13–20-II-2017, 20–27-II-2017, 7–13-III-2017, 1–8-V-2017, 16-VI–5-VII-2017, 21–30-V-2018, 24–30-I-2019; 2 larvae, 2 pupae: Coral Gables, 755 Tiziano Ave., *Livistona chinensis*, 20-VIII-1993, D. Fisk; 3 larvae: Coral Gables, ARS SHRS, 25.64236, −80.29494, 30-XI-2018, *Zombia antillarum*, J. Hayden, S. Bolton, 1 larva: Homestead, 10295 SW 248 St., 25.5434, −80.3573, 8-I-2019, *Cocos nucifera*, J. Piontek; 2 larvae, 2 pupae: Homestead, 25.5327, −80.4917, 29-XI-2018, *Cocos nucifera*, J. Hayden; 4 larvae: Miami, 3011 NW 18 Terr., 25-VI-1975, *Latania* sp., W.S. Brewton, J.T. Loyd; 4 larvae: Miami, 7821 SW 22 St., on *Livistona chinensis*, 29-VIII-2017, G. Gonzalez, E17-3497, MGCL slide 5577 (larval cuticle); 2 pupae: same data; 2 larvae: Miami, 19600 SW 136 St., on *Cocos nucifera*, 10-X-2019, H. Carmenate, Y. Perez, MGCL slide 5663 (larval cuticles); 5 larvae: Opa-Locka, 17700 NW 19th Ave., 20-I-1987, *Latania*, L.F. Davis; **Palm Beach Co.:** 1 larva, 1 pupa: Boca Raton, 420 NE 35th St., 6-III-1980, *Cocos nucifera*, Malayan Palm, M. Sanders, E1980-1536; 1 larva: Lantana, 5367 Second Rd., 8-VI-1983, *Latania lontaroides*, R. Buchholz, E1983-2395.

**Diagnosis.** *Adult*. The second segment of the labial palpus has scattered black scales, more concentrated distally, and a dorsal scale tuft (Fig. 9), whereas the other common species have the palp uniformly gray exteriorly. The third (apical) segment is nearly as long as the second. The antennae are slightly longer than the forewings; they are shorter in *H. sabalella*. The scape has a pecten, absent in *H. sabalella*. The forewings are beige with scattered black scales, and the terminal black spots are present but less discrete than in other species (Fig. 3, 4); among the other described species, only *H. octagonella* (Walsingham) also has scattered black scales. The male hind wing has a hair pencil from the posterior margin at the base that fits underneath the abdominal dorsal scale tuft (Fig. 16). Forewing $Rs_2$ and $Rs_3$ are stalked, and $M_1$ is fused with them, having a weak but distinct base and diverging from $Rs_3$, or else $M_1$ is slightly separate and weak (Fig. 35). One of the CuA veins is absent in both the forewing and hind wing. On the male abdomen, tergite 2 narrows posteriad in a Y-shape, and tergite 3 is very narrow and linear (Fig. 12). These two tergites bear lateral tufts of broad brown-gray scales that fold over the hind wing hair pencils. *Homaledra sabalella* and the species described below have unmodified tergites. *Male genitalia*: The phallus has a short row of small cornuti (Fig. 23). The apex of the valva is roundly attenuate (Fig. 18). *Female genitalia*: The corpus bursae is arachiform (peanut-shaped) with a medial constriction (Fig. 30); it is pyriform in *H. sabalella*. The round, spinose signum is located halfway along the posterior expansion, and the spines are larger on one side than the other (Fig. 31); the signum is similar in *H. sabalella,* but the species below has a granular field. *Larva* (Fig.

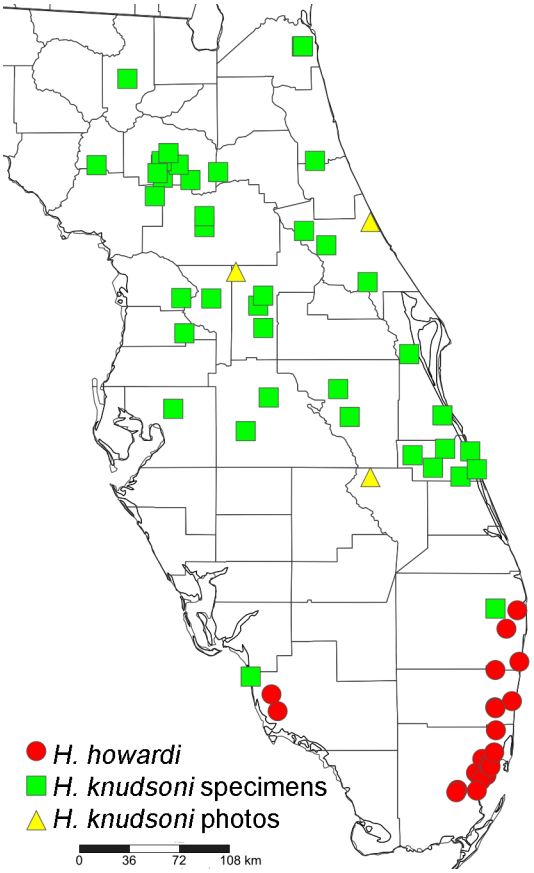



**Figure 59.** Distribution in peninsular Florida of *H. howardi* (red circles) and *H. knudsoni* (green squares: specimens; yellow triangles: photographs on line).

39). The subventral group on A3–A6 has 5 or rarely 6 setae: three large setae nearer the crochets and two or three small ones proximad on the proleg (Fig. 42). A1 and A2 also have small accessory setae next to SV1, 2, and 3. The other species have fewer SV setae, and all are uniform in size. *Pupa* (Fig. 46). The antennae and metathoracic legs are longer than the wings and are extended onto the 5th abdominal segment, in some specimens to the end of the 6th segment; the antennae are not tangent, being narrowly separated by the legs along the whole length.

Male *Homaledra octagonella* have abdominal tergites like *H. howardi*: T2 is triangular, narrowing posteriad, and T3 is a narrow ridge, flanked by enlarged pleural scales (Fig. 15). *Homaledra octagonella* differs in having white wings with scattered black scales and larger discal and anal spots (Fig. 49); the labial palpus is mostly white, and the second segment has gray lateral scales but without scattered colored scales or a tuft. The size of *H. octagonella* is much smaller (wing length 4.5–5.0 mm). In the male genitalia of *H. octagonella* (Fig. 21), the cornuti are not evident (Fig. 26) (MGCL slide 4542). The female has an echinoid signum, about 1/3 from the anterior end of the evenly sack-shaped corpus bursae (USNM slide 86,403, Kirbyville, Texas).

**Description.** *Head* (Fig. 9). Haustellum white-scaled; frons cream ventrally, black medially below level of antennae, black overlain by pale yellow scales in fresh specimens; frons dorsally gray and brown with black anterior of antennae; vertex brown; antennal scape dorsally with two dark-gray areas, ventrally cream, with pecten of about six cream-color scales; pedicel not visible, flagellum brown with some dorsal gray scales, longer than wings; ocelli absent; maxillary palpi cream; labial palpi with proximal segment cream, second segment cream with many dark gray ventral scales and few brown scales, scales erect dorsally in loose subapical tuft in both sexes; distal labial segment brown with few gray scales.

*Thorax.* Prothorax behind head dark gray; rest of thorax brown dorsally, cream ventrally. Prothoracic leg coxa cream, femur cream with gray anterior edge, tibia gray with few cream scales, forming two tufts in

subproximal and distal positions; tarsi gray and cream. Mesothoracic leg mostly cream with small gray spot on dorsal side of tibia and one at end of tarsus; one pair of tibial spurs present. Metathoracic leg mostly cream except tibia pale gray along whole dorsal side, with long hairlike scales; two pairs of tibial spurs present. Forewing (Fig. 3, 4) length 6.0–8.0 mm ($n$ = 10), dorsal side brown with irregularly scattered dark gray scales; black spots at end of discal cell and terminal ends of veins present but small, black spot absent from anal fold; edge of costa pale; ventral side gray; fringe brown and gray. Male with chitinous retinacular hook. Forewing venation: $Rs_4$ and $M_1$ stalked, the stalk weak and anastomosed with $Rs_3$ (alternatively $Rs_4$ stalked with $Rs_3$, $M_1$ fused with $Rs_4$ at length); only one CuA vein present (Fig. 35). Hind wing dorsally and ventrally gray, fringe brown on costa, gray on posterior margin. Female with two frenular bristles; male with one. Male with paired hair pencils of long cream scales arising immediately below base of hind wing (Fig. 16). Hind wing venation: $M_1$ and $M_2$ short-stalked or connate; only one CuA vein present.

*Abdomen.* Dorsal side brownish gray, including enlarged tergal scales of male; ventral side pale brown or dark cream. Tergites I–VII of male (Fig. 12) sclerotized and bearing spines in irregular distribution over entire tergite (not in rows); tergite I of male square with convex lateral margins; tergite II narrowed posteriad with concave margins, bordered by one row of enlarged scales; tergite III evenly narrow, surrounded by irregular scales on membrane and outwardly by a row of enlarged scales; tergites IV–VII approximately square without large scales; tergite VIII membranous. Tergites I–VI of female all square or nearly so, not narrowed, and bearing small spines as in male; tergite VII rectangular but without spines. Eighth abdominal segment of female brownish yellow, pale brown in male.

*Male genitalia* (Fig. 18, 23). Uncus hooked, subapically enlarged and laterally compressed; gnathos absent; transtilla a pair of narrow sclerotized straps in membrane, meeting mesally; juxta broadly rectangular with ventral concavity; valva elongate, without fibula, setose along ventral half, with low, seta-bearing subcostal ridge and rounded apex; saccus not pronounced; tegumen with sclerotized medial longitudinal ridge. Phallus with sclerotized strap entire length; small cornuti in one small patch on vesica.

*Female genitalia* (Fig. 30, 31). Ostium bursae without sclerites; colliculum present; ductus seminalis attached to ductus bursae just anteriad of colliculum; ductus bursae with granular texture on one side. Corpus bursae 2 mm in total length, as long as ductus bursae; oblong and arachiform (peanut-shaped) with medial constriction; anterior half smooth and weakly striate; posterior half with granules like those on ductus bursae; one round signum in center of posterior half, with numerous blunt spines in asymmetric arrangement, about three on one side larger than others.

*Larva* (Fig. 39, 42, 44). SV group on A3–A6 with 5 or rarely 6 setae: 1 large seta anterior of crochets, 2 large setae anterolateral of crochets, and 2–3 small setae lateral and proximad of those.

**Etymology.** This species is named for Prof. Forrest W. "Bill" Howard, who first discovered the infestations of this species in South Florida and who studied its bionomics extensively.

**Distribution.** Fig. 59. Southern Florida, U.S.A. and Dominican Republic.

**Host plants.** *Bismarckia nobilis* Hildebr. and H. Wendl., *Cocos nucifera*, *Corypha umbraculifera* L., *Corypha* sp., *Latania lontaroides* (Gaertn.) H.E. Moore, *Latania* sp., *Livistona chinensis* (Jacq.) R. Br., *Sabal palmetto*, *Sabal* sp., *Serenoa repens*, *Thrinax* sp., *Washingtonia robusta*, *Zombia antillarum* (Descourt) L.H. Bailey. Larvae have been collected most often on *Cocos, Washingtonia* H. Wendl., and *Livistona* R. Br. (Howard 1996), but the earliest larval lots are from *Latania*. Because of confusion with other *Homaledra* species, all records must be confirmed by examination of specimens.

**Larval behavior.** The larvae live in small groups underneath frass tubes on palm leaves. They are capable of infesting single pinnules of coconut palms (Fig. 53, 54), albeit without tying them together with stronger silk. When on palm leaves that are not pinnate, they make large patches of randomly directed frass tubes like the other species described below (Fig. 55).

**Remarks.** Male specimens of *H. howardi* are readily diagnosed by the tufts of large dorsal abdominal scales and the associated thoracic androconia. The abdominal scales are easily overlooked on dried pinned specimens because they are appressed to the body, but they are easily visible in moths collected into alcohol, as they are dilated by abdominal distention. It is likely that the initial determination as *H. sabalella* was based on dried specimens. The numerous other differences in maculation, venation, female genitalia, and larval chaetotaxy corroborate that it is specifically distinct from *H. sabalella*. The narrow terga and associated male sex scales are structures shared between *H. octagonella*, *H.*

*howardi*, and the undescribed Puerto Rican palm-leaf skeletonizer. The case-bearing, lichenivorous larval behavior of *H. octagonella* is unique among *Homaledra* species as far as known.

Examination of preserved larvae show that *H. howardi* was present in Miami in 1975 and Boca Raton by 1980, two decades before they were noticed by Dr. Howard in Fort Lauderdale. The three early records on *Latania* palms could reflect host preference, movement of ornamental palms, or accessibility of the foliage for collection; these possibilities are speculative. It is possible that *H. "sabulella"* [sic] identified by Russo (1927) as a pest of coconut and other palms in the Dominican Republic in fact refers to *H. howardi*. The slide-mounted dissection in the USNM was collected about the same time as Russo's report. Efforts to search the collections of the Museo Nacional de Historia Natural (Santo Domingo) have been impeded by the current Covid-19 pandemic restrictions.

The mtDNA COI "barcode" sequence is not yet represented by a BIN on BOLD. Sequences for samples E2017-3497 (from which the holotype was chosen) and E2018-4018 are available on GenBank with respective accession numbers MW549054 and MW549055. The merged sequence of the two is as follows:

TATATTTTATTTTTGGAATTTGAGCAGGAATAGTTGGAACTTCACTTAGTTTATTAATTCGAGCTGAATTAGGAAATCC
AGGTTCTTTAATTGGAGATGATCAAATTTATAATACAATTGTAACAGCTCACGCTTTTATTATAATTTTTTTCATAGTTAT
ACCCATTATAATTGGAGGTTTTGGAAATTGATTAGTYCCTTTAATACTAGGAGCTCCCGATATAGCTTTCCCCCGAATA
AATAATATAAGATTTTGACTTCTTCCCCCTTCATTAACCCTTTTAATTTCAAGAAGAATTGTAGAAAGAGGAGCAGGTA
CTGGTTGAACAGTTTATCCTCCTTTATCATCTAATATTGCTCATGGAGGAARATCTGTAGATTTAGCAATTTTTTCTTTA
CACTTAGCTGGTATTTCTTCTATTTTAGGGGCAATTAACTTTATTACTACAATTATTAATATACGAATTAATAACATATCT
TTTGATCAAATACCCCTATTTGTTTGAGCTGTTGGAATTACTGCTCTTTTATTACTTTTATCTTTACCAGTTCTTGCAGG
AGCAATTACTATATTATTAACTGATCGAAATCTTAATACATCATTCTTTGATCCTGCGGGAGGAG

### *Homaledra knudsoni* Hayden, new species

(Fig. 5–7, 10, 13, 19, 24, 32, 33, 36, 40, 43, 47, 56–59)

**Type material.** Holotype: ♂: [white label] "Cameron Co. Tex. Brownsville leg. E.C. Knudson 27-X-86" (MGCL).

Paratypes: **MEXICO:** 1♂: Quintana Roo, Allen Point Ascension Bay, 17-IV-1960, J.F.G. Clarke, [green label] Genitalia Slide By RWH, male, USNM 15,045, R.W.H. #788, 20-IX-1960, *Homaledra sabalella* (Chamb.) (USNM). **USA: Florida: Alachua Co.:** 1♂: Gainesville, UF Campus, FLMNH Butterfly Rainforest, UV trap, XI-2011, Hansen and Fessenden; 1♀: same data, MGCL slide 4439; 1♂: same data, MGCL slide 4440; 2♂: Gainesville, 3215 Hull Rd., UF Butterfly Rainforest, larva on *Washingtonia robusta*, 19-XI-2017, J. Hayden, K. Curry, E17-4800; 1♂: Gainesville, Split Rock C.A., 29.63658, −82.40965, Pupa on cabbage palm, 12-IX-2017, J. Hayden, eclosed 25-IX-2017, E2017-3805; 1♀: same data, MGCL slide 4437; 1♂: same data, MGCL slide 4438; 2♀: Gainesville, UF NATL, SW 34 St. & 24 Ave., 29.63038, −82.37226, on *Sabal palmetto* leaf, 28-XI-2017, J. Hayden; 5♂, 2♀: same data except 29.6307, −82.3718, 9-VI-2018; 3♂, 4♀: same data except 29.6345, −82.3704, 16-VIII-2018; 5♂, 2♀: same data except 29.3663, −82.3706, 13-VIII-2018, J. Hayden, H.A. Rohrer; 1♀: same data except 29.3663, −82.3706, 13-VIII-2018, J. Hayden, H.A. Rohrer, MGCL slide 5007 (wings); 1♂, 3♀: Gainesville, 3722 SW 19 St., 29.617956, −82.348579, on *Sabal palmetto*, 24-I-2018, P. Skelley, J. Hayden, E18-236 (1♂: USNM, rest FSCA); 1♂: same data, slide MGCL 4580 (FSCA); 2♂, 2♀: Gainesville, SW 41 Pl. south of UF TREEO, ex *Sabal palmetto* leaf, NW side of road, 22-X-2017, J. Hayden; 2♂, 3♀: Micanopy, County Rd 346, bridge at River Styx, 29.517163, −82.222084, ex *S. palmetto* leaf, 22-X-2017, J.S. Bremer, E17-4018 (1♂, 1♀: USNM, rest FSCA); 1♀: Micanopy, 13207 SW Williston Rd., on *S. palmetto*, 5-III-2018, J. Hayden, J.Y. Miller, E18-845, MGCL slide 4673; 1♂, 1♀: Gainesville, Museum Rd west of Lake Alice, larva on *Sabal palmetto* leaf, 26-XI-2017, J. Hayden (♀: USNM, ♂: FSCA); 1♂, 1♀: Gainesville, 2004 SE 41st Ave., 29.6164, −82.2987 *Sabal palmetto*, 21-VII-2018, J. Hayden, E. Robertson, J. Mays, J. Awad, E18-4053; 1♂: 6400 SW 20th Ave., 29.64142, −81.41091, UV light, 23–24-II-2019, J. Hayden; 4♂: Gainesville, across from 6400 SW 20th Ave., 29.6394, −82.4100, *Sabal palmetto*, 3-VI-2018, J. Hayden; 1♂: same data, MGCL slide 5004 (wings); 2♂, 10♀: Gainesville, 10014 SW 87 Terrace, Reared from leaf of *Sabal palmetto*, leaf coll. 7-XI-2018, Lyle J. Buss; 1♂: same data, MGCL slide 5015 (1♂, 1♀: USNM, rest FSCA); 1♂: Gainesville, 2832 NW 41st Place, 29.6922, −82.3650, UV light trap, 24–25-IX-2019, J. Hayden; 1♂: same data except 25-III-2020, UV light; **Brevard Co.:** 1♂: Cocoa, 1545 Alligator Lane, 28.3838, −80.7980, on *S. palmetto* (?), 17-IV-2018, D. Cermak, E18-1920; 1♂: Melbourne, Weston Park, UV, 8-XII-2017, M.F. Blaine; 1♂: same data, 9-I-2018; **Citrus Co.:** 2♀: Floral City, 9065 E. Bushnell Rd. on *Sabal palmetto*, 15-V-2018, J. Hayden, E18-3023; 1♂: same data, MGCL slide 5005 (wings); **Collier Co.:** 2♀: Naples, Delnor-Wiggins Pass State Park, malaise trap, 24-IV–27-V-2020, D. Serrano; **Duval Co.:** 2♂: St. Johns Bluff, Timucua National Park, Fort Caroline, 30°23′09″N 81°29′49″W, malaise trap, 24-VIII–7-IX-2018, E. Talamas, D. Taradona; 1♂: same data except Ribault Column, 30°23′16.4″N 81°29′21.5″W, malaise trap, 2–23-XI-2018, MGCL slide 5185; **Gilchrist Co.:** 3♂: Trenton, Rte 26 x SW 15 Ct, 29.6137, −82.8330, ex *S. palmetto*

leaf, 18-X-2017, M. Standridge, J. Bremer, E17-4013; **Hernando Co.:** 1♀: Brooksville, E. side La Pine Rd. 28.5196, −82.2615, on *Sabal palmetto*, 28-IV-2018, N. Marquez, E18-1403, MGCL slide 5006 (wings); **Indian River Co.:** 1♂: Vero Beach, FL A1A, 27.6348, −80.3577, on *Serenoa repens*, 1-XI-2018, A. Tasi, E18-6027; 1♀: Vero Beach, Cap. Forster Hammock Prsv., 27.5710, −80.4004, reared on *S. palmetto* leaf, 17-X-2018, A. Tasi, E18-5795; 4♀: Vero Beach, 6618-7072 9 St. SW-Oslo Rd., 27.587°N, 80.464°W, 4-XI-2018, T. Greenwald, M.E. Flowers, E18-5798; 1♂: 11738-11360 CR 512, St. Sebastian Prsv., 27.768°N, 80.564°W, 4-XI-2018, T. Greenwald, M.E. Flowers, E18-5856; 2♂, 2♀: Vero Beach, 4593-4599 Blue Cypress Rd., 27.726°N, 80.776°W, 4-XI-2018, T. Greenwald, M.E. Flowers; 1♂: Vero Beach, 4016-4050 CR 512, 27.645°N, 80.643°W, 4-XI-2018, T. Greenwald, M.E. Flowers; **Lake Co.:** 2♂, 2♀: Howey in the Hills, Highway 19, 28.699279, −81.780483 on *S. palmetto*(?), 21-II-2018, N. Marquez, A. Bartlett, E18-688; 1♂: same data except E18-689, MGCL slide 4608; 1♀: Tavares, Lake Idamere Park, 28.76455, −81.74842 ex frass on *S. palmetto*, 16-V-2018, J. Hayden, E18-2826; 3♂: same data except 3-X-2018, J. Hayden, E18-5348; **Levy Co.:** 3♂, 6♀: US 41 N. of Williston, 29.41196, −81.45341, *Sabal palmetto*, 22-IV-2018, J. Hayden, E18-2064; **Marion Co.:** 1♂: Ocala, IFAS Extension, 2232 NE Jacksonville Rd. 29.21114, −82.13074, on *Sabal palmetto*, 29-I-2018, J. Hayden, B. Danner, E18-846, MGCL slide 4615; 2♂, 2♀: Ocala, 9036 W. Anthony Rd., 29.28211, −82.13057, *Sabal palmetto*, 4-III-2018, J. Hayden, T. Dickel, E18-946; 1♀: same data, MGCL slide 5003 (wings); 1♂, 3♀: same data except 29.28231, −82.12926, E18-1012 (1♀: USNM, rest FSCA); 1♀: same data except 29.28332, −82.13414; **Osceola Co.:** 1♂, 1♀: St. Cloud, 4464 La Salle Ave. S., Larvae on *Washingtonia robusta,* 17-VIII-2018, R. Areingdale, E2018-4414; 1♂: same data except E2018-4464; 7♂, 3♀: Kissimmee, Joe Overstreet Rd. S. of Canoe Creek Rd., 15-XII-2017, on *Serenoa repens*, T. Greenwald, M.E. Flowers, E18-155; 1♂: same data, MGCL slide 4564; 1♂: same data, MGCL slide 5008 (wings); **Palm Beach Co.:** 3♂: Royal Palm Beach, 150 Crestwood Blvd N. on *S. palmetto*, 6-XII-2018, J. Hernandez, E18-6306; 1♂: same data, MGCL slide 4990; **Polk Co.:** 2♂: Lake Alfred, CREC Experiment Sta. Rd., 28.10184, −81.71229, reared on *S. palmetto* leaf, 10 Jan. 2019, J. Hayden, E19-165; 1 larva, molecular analysis: Bartow, 1432 CR 555 S., 4-I-2018, *Livistona chinensis*, J. Bryan, R. Areingdale, E18-54; **Putnam Co.:** 1♂, 1♀: 3.2 mi. SE of Hawthorne, vic. Little Orange Lake, 29.568291, −82.041721, on *Sabal palmetto* leaf, 8-X-2017, T.A. Lott, D. Matthews, E2017-3858; 1♀: same data, MGCL slide 4449; **Sumter Co.:** 1♀: Sumterville, E. side CR 529A, 28.7459, −82.0862, on *S. palmetto*, 9-III-2018, N. Marquez, E18-1003; **Volusia Co.:** 1 larva, molecular analysis: De Land, 29.09227, −81.33740, 29-I-2018, *Sabal palmetto*, K. Loadholtz, E18-323; 1♂: Osteen, 492 Pell Rd., 28.852463, −81.068803, on *S. palmetto*, 12-II-2018, K. Coffey, E18-659; 1♂: Pierson, 1725 Stone Rd., 29.1854, −81.4826, on Jax. trap, 10-XII-2018, P. Sullivan, E18-6407; **TEXAS: Cameron Co.:** 1♂: same data as holotype (MGCL); 1♂: Southmost, 27-X-1986, E.C. Knudson, Barcode of Life DNA voucher specimen, SampleID CCBD-28560-D04, BOLD Proc. ID: LNAUU040-15, USNMENT 01048494 (USNM); 1♂: same data except "Southmost", MGCL slide 4442; 1♀: Sabal Palm Sanct., 4,5-XII-1994, E. Knudson; 1♀: same data except 29-IV-1995, MGCL slide 4441.

**Other material examined. USA: Florida: Alachua Co.:** 1♂: Gainesville, UF NATL, SW 34 St. & 24 Ave., 29.63038, −82.37226, Pupa on *Sabal palmetto* leaf, 9-X-2017, J. Hayden, MGCL slide 4448; 1 larva: same data except 29.6304, −82.3717; 1♀: same data except 29.63446, −82.37056, 5-X-2017; 1 larva: Gainesville, UF NATL, SW 34th St., 29.6336, −82.3706, on *Sabal palmetto*, 13-VIII-2018, J. Hayden, H.A. Rohrer, MGCL slide 4854 (larval cuticle); 1 larva (molecular sequencing): same data except: sample JEH20180813E; 1 larva: Gainesville, NATL, 29.6345, −82.3704, 16-VIII-2018, *Sabal palmetto*, J.E. Hayden; 1 larva (molecular sequencing): Gainesville, SW 41 Pl. S. of UF TREEO, ex *Sabal palmetto* leaf on NW side of road, 22-X-2017, J. Hayden, sample JEH20171121A; 3 larvae: Gainesville, NATL, 15-XII-2018, *Sabal palmetto*, J.E. Hayden, K. Ellis; 1 larva: Gainesville, FLMNH Butterfly Rainforest, 19-XI-2017, *Washingtonia robusta*, K. Curry, J.E. Hayden; 2 larvae: Gainesville, 3722 SW 19 St., 29.6180, −82.3486, 24-I-2018, *Sabal palmetto*, J.E. Hayden, P. Skelley; 1 larva: Micanopy, 29.5172, −82.2221, 22-X-2017, *Sabal palmetto*, J. Bremer; 1 larva: Micanopy, 13207 SW Williston Rd., 5-III-2018, *Sabal palmetto*, J.E. Hayden, J.Y. Miller; **Brevard Co.:** 2 larvae: Cocoa, 28.3838, −80.7980, 17-IV-2018, *Sabal palmetto*, D. Cermak; **Columbia Co.:** 2 larvae (1 preserved, 1 molecular sequencing): Lake City, 30.1753, −82.6325, 19-I-2019, *Sabal palmetto*, M.E. Flowers, T. Greenwald, E2019-212; **Hernando Co.:** 2 larvae: Brooksville, La Pine Rd., 24.5196, −82.2615, 28-III-2018, *Sabal palmetto*, N. Marquez; **Hillsborough Co.:** 1♂: Seffner, 8682 Williams Rd., on *Butia capitata*, 15-II-2018, T. Streeter, MGCL slide 4601; 1 larva: same data, not slide-mounted; **Indian River Co:** 2 larvae: Vero Beach, 27.5870, −80.4640, 4-XI-2018, *Sabal palmetto*, T. Greenwald, M.E. Flowers; **Lake Co.:** 1 larva, 2 pupae: Clermont, 28.554211, −81.747638, on *Sabal palmetto*, 16-I-2018, A. Bartlett, N. Marquez, E2018-175; 1 pupa: Howey in the Hills, on *S. palmetto*, 2-II-2018, N. Marquez, A. Bartlett; 1 pupa: Howey in the Hills, 28.6993, −81.7805, 21-III-2018, *Sabal palmetto*, N. Marquez, A. Bartlett; 1 larva: Tavares, 28.7646, −81.7484, 16-V-2018, *Sabal palmetto*, J.E. Hayden; 4 larvae: same data except 3-X-2018; **Marion Co.:** 1 larva: Ocala, 29.2821, −82.1306,

4-III-2018, *Sabal palmetto*, J.E. Hayden, T.S. Dickel; **Osceola Co.:** 1 larva: Kenansville, Three Lakes WMR, 27.942, −81.152, 2-XI-2018, *Serenoa repens*, M. Flowers, T. Greenwald; 2 larvae (molecular samples): St. Cloud, 4464 La Salle Ave. S., 17-VIII-2018, *Washingtonia robusta*, R. Areingdale, samples E2018-4413, E2018-4414; **Palm Beach Co.:** 5 larvae, 1 pupa: Royal Palm Beach, on *S. palmetto*, 6-XII-2018, J. Hernandez; **Polk Co.:** 2 larvae: Bartow, 1432 CR 555 S., on *Livistona chinensis*, 4-I-2018, J. Bryan and R. Areingdale, E2018-54; **Sumter Co.:** 2 larvae: Sumterville, 28.7459, −82.0862, 9-III-2018, *Sabal palmetto*, N. Marquez; **Volusia Co.:** 1 larva: De Land, 29.09227, −81.33740, on *Sabal palmetto*, 29-I-2018, K. Loadholtz, E2018-323.

**Diagnosis.** *Adult*. The antennae are distinctly longer than the forewings and gray at the apex, whereas they are shorter than the wings and unicolorous in *H. sabalella*. Most specimens have a pecten on the scape, which *H. sabalella* lacks. The forewings are beige with white scales on the veins, especially along the radial veins (Fig. 5, 6, 7). The terminal black spots are more prominent and extend farther basad, including a spot at the end of R1 (anterior of the discal spot) and in some specimens basad of R1. Forewing vein $M_1$ is close or anastomoses with $Rs_{3+4}$, the forewing CuA veins are usually separate or less often fused, and the hind wing CuA veins are separate (Fig. 36). The hind wings are darker gray than those of *H. sabalella*. The male tergum has slightly enlarged pleural scales but is otherwise unmodified (Fig. 13). *Male genitalia*: The cornuti are large, numerous, and melanized (Fig. 24). *Female genitalia*: The corpus bursae is pyriform in shape, widest at the anterior end (Fig. 32). The signum is a diffuse, elongate zone of granules on anterior end of the corpus bursae (Fig. 33). *Larva* (Fig. 40). The subventral group on A3–A6 has four setae of similar size: one anterior of the proleg and three anterolateral of it (Fig. 43). *Pupa* (Fig. 47). The antennae and metathoracic legs are longer than wings and are extended to the end of the 6$^{th}$ abdominal segment; the antennae are tangent, concealing the legs at the 3$^{rd}$ abdominal segment.

The signum of *H. sabalella* and *H. howardi* has a discrete edge and bears spines. *Homaledra citraula* (Meyrick) has cornuti that are similarly large and melanized (Clarke 1965: pl. 254 fig. 1a). That species is distinguished by wing pattern, which is yellow with orange and gray streaks.

**Description.** *Head* (Fig. 10). haustellum dark gray; maxillary palpi gray; labial palpi with proximal segment gray, second segment dark gray except cream in dorsal 2/5 and around distal margin, without dorsal tuft; distal segment brown with few pale gray scales. Frons entirely dark gray below level of antennae, brown dorsally. Ocelli absent. Antennal scape dorsally brown, ventrally cream with row of single gray scales along anterior edge, pecten of 1 to 5 fine gray scales near base, often lost; pedicel and flagellum mostly brown, gray at apex, longer than wing.

*Thorax.* Prothorax behind head dark gray; rest of thorax brown dorsally, cream ventrally. prothoracic leg coxa gray, femur gray, tibia gray with dark gray and cream scales, bearing erect hairlike scales along whole length of dorsal side; tarsi gray and pale brown. Mesothoracic leg femur gray, tibia gray, tarsus pale brown; one pair of tibial spurs present. Metathoracic leg mostly cream except tibia pale gray along whole dorsal side, with long hairlike scales; two pairs of tibial spurs present. Forewing (Fig. 5, 6, 7) length 6.0–9.0 mm, usually 7.0 mm or longer (*n* = 20); dorsal side brown, with cream scales along veins, especially in distal half; a black spot at distal end of discal cell, another black spot along anal fold, and veins terminating in black spots on anterior and posterior margins; costal margin cream; ventral side gray; fringe gray. Forewing venation: $Rs_4$ stalked with $Rs_3$, $M_1$ variably parallel to $Rs_3$+$Rs_4$, stalked with them, or anastomosed with $Rs_4$; $CuA_1$ and $CuA_2$ separate in most specimens, stalked in one specimen (Fig. 36). Hind wings with dorsal and ventral sides and fringe uniformly gray. Hind wing venation: $M_1$ and $M_2$ shortly stalked; $M_3$, $CuA_1$, and $CuA_2$ present and separate.

*Abdomen.* Dorsal side brownish gray, ventral side cream; eighth segment gray in female, brown in male.

*Male genitalia* (Fig. 19, 24). Uncus hooked, slightly enlarged medially; gnathos absent; transtilla a pair of narrow sclerotized straps in membrane, meeting mesally; juxta a broad pentagon, ventral margin straight or slightly concave; valva elongate, without fibula, setose along ventral half, with few setae along dorsal half, the proximal half of costa being rather strongly arched; saccus not pronounced; tegumen with sclerotized medial longitudinal ridge. Phallus with sclerotized strap entire length; large cornuti in one large field on vesica.

*Female genitalia* (Fig. 32, 33). Ostium bursae without sclerites; colliculum present; ductus seminalis attached to ductus bursae just anteriad of colliculum; anterior end of ductus bursae with granular texture on one side. Corpus bursae slightly shorter than ductus bursae; anterior section 1 mm long, ovate; posterior section 1.5 mm, narrow and straight; one longitudinally elongate, diffuse signum occupying most of anterior section.

*Larva* (Fig. 40, 43). SV group on A3–A6 with 4 large setae: 1 anterior of crochets and 3 anterolateral of crochets.

**Etymology.** The species is named after Dr. Edward C. Knudson, who collected specimens in the Lower Rio Grande Valley as part of his decades-long Texas Lepidoptera Survey. His donation of specimens to the Florida Museum of Natural History allowed timely recognition of this species' probable origin.

**Distribution.** Fig. 59. Southern Texas, Mexico (Yucatan Peninsula), and peninsular Florida, from Duval County in the north to Palm Beach and Collier Counties in the south.

**Hosts plants.** This species is most frequently reared on *Sabal palmetto* and *Washingtonia robusta*, infrequently on *Butia capitata*, *Livistona chinensis*, and *Serenoa repens*. It is reported on *Trachycarpus* H. Wendl. in cultivation (R. Fessenden, FLMNH, pers. comm. 2018).

**Larval behavior.** The larvae coexist in large numbers in frass-covered silken tubes on protected parts of leaves, usually the abaxial side, but also the adaxial side along the rachis when deeply folded. The tunnels are as wide as the larvae, and they wind randomly across the leaf surface in large patches (Fig. 56, 57). During the day, larvae often hide in sections of the tubes near the base of the leaf. If larvae are difficult to find, active damage can be recognized by the leading ends of frass tubes with fresh, greenish frass extending onto undamaged epidermis (Fig. 58). The larvae do not bind leaf sections with thick mats of silk, unlike *H. sabalella*.

**Remarks.** This species is figured in Knudson and Bordelon (2008), plate 2, fig. 10, misidentified as *H. sabalella*. It is apparently geographically separated from *H. sabalella* in eastern Texas (E. Knudson, pers. comm. 2018). This species probably appeared in Florida as early as 2006, evidenced by a photograph of a moth posted on Bugguide.net (Lady Lake, Lake County, FL, 29 Nov. 2006) (White 2006). Figures 2–4 in Howard and Abreu (2007) show leaf damage that is characteristic of *H. knudsoni* rather than *H. sabalella*; that would be contemporaneous, but the locations and exact dates of their photographs are not given. Specimens of *H. knudsoni* were not found among Howard's reared material.

*Homaledra knudsoni* is represented by BIN BOLD:ACJ4987 (https://doi.org/10.5883/BOLD:ACJ4987), which is based on two specimens: USNMENT 01048494 and GenBank accession JF818757.1. The latter sample (voucher no. MM11439) was misidentified as *H. sabalella* and included in the gelechioid phylogeny of Kaila et al. (2011). The larvae were collected in Gainesville in 2010 (L. Buss, pers. comm. 2019). Five other genes were sequenced, so the amended identification should not affect the higher-level phylogenetic conclusion that *Homaledra* is associated with Pterolonchidae.

The COI barcode sequences have the same haplotype; for example, the sequence of E2018-4413 is:

TTTGAGCAGGAATAGTAGGAACTTCTCTTAGTCTTCTAATTCGAGCTGAATTAGGAAATCCAGGTTCTTTAATTGGAGA
TGATCAAATTTATAATACAATTGTTACAGCTCATGCTTTTATTATAATTTTTTTTATAGTTATACCAATTATAATTGGTGG
ATTTGGAAATTGATTAGTCCCTTTAATATTAGGAGCCCCTGATATAGCTTTCCCTCGAATAAATAATATAAGATTTTGAC
TTCTTCCCCCTTCTTTAACTCTTCTTATTTCAAGAAGAATTGTTGAAAGAGGAGCAGGAACTGGATGAACAGTATATCC
CCCACTTTCATCCAATATTGCCCATGGAGGTAGATCTGTAGATCTAGCAATCTTTTCTTTACATTTAGCAGGAATTTCAT
CAATTTTAGGAGCTATTAATTTTATTACTACAATTATTAATATACGAATTAATAATATATCATTTGATCAAATACCTTTATT
TGTATGAGCAGTAGGAATTACTGCTTTACTACTTTTACTCTCTTTACCCGTTTTAGCTGGTGCAATTACCATATTATTAA
CTGATCGTAATTTAAATACATCATTTTTTGACCCTGCAGGAGGAGGAGA

Other sequences available on GenBank with the following accession numbers (full data in Material Examined): sample JEH20180813E: MW549056; E2017-3858: MW549057; JEH20171121A: MW549058; E2018-4413: MW549059; E2019-212: MW549060.

**Other species.** The species raised by Abreu in Puerto Rico (Howard and Abreu 2007) is not conspecific with *H. howardi*. It resembles *H. howardi* in that the beige wings have scattered black scales not concentrated in spots, and the males also have a distinct tuft of scales on the dorsal abdomen. Unlike *H. howardi*, the scales are short, fine, erect and black in color, forming a circular cushion-like patch. Tergum II narrows as a triangle instead of a Y, and there is a pocket of scales on the membrane between terga II-III that is revealed after brushing off the black scales. The phallus lacks cornuti except a few small spinules. The valvae are narrower than any other species. In the female, the corpus bursae is carrot-shaped, broadest posteriad where it meets the ductus bursae, and a signum is absent.

*Homaledra heptathalama* Busck distinctly differs in its orange wing pattern with a central exclamation point "!" (Fig. 48). Males lack a dorsal abdominal scale tuft (Fig. 14), the apex of the valva is more strongly attenuate than that in the other species (Fig. 20), and cornuti are absent (Fig. 25). Females were not examined: all of the numerous pinned specimens of *H. heptathalama* in the FSCA are males, so females may not be attracted to light, the usual collection method. Rearing females from late-instar larvae should be attempted.

### *Homaledra heptathalama* Busck

(Fig. 48)

**Material examined. USA: Florida: Alachua Co.:** 1♂: Austin Carey Forest, 12–17-IX-1975, Malaise trap, G.B. Fairchild; **Collier Co.:** 1♂: Collier Co. St. Pk., 8-I-1988, J.B. Heppner, MGCL slide 5029 (wings); **Flagler Co.:** 1 larva: Palm Coast, 29.6594, −81.2419, 9-I-2019, *Sabal palmetto*, M. Cain, D. McColl, C. Hall; **Franklin Co.:** 1♂: Apalachicola Natl. Fst., nr. Hickory Lndg. Cmpgd., NFR 101B, 1-IX-1991, H.D. Baggett; **Highlands Co.:** 1♂: Archbold Biol. Res. Sta. flight trap, 9-IX-1979, H.V. Weems, S. Halkin, MGCL slide 4260; **Indian River Co.:** Vero Beach, 2-V-2002, *Sabal palmetto*, D.H. Baquerizo, L238; **Jefferson Co.:** 1♂: Goose Pasture, 31-VIII-1991, H.D. Baggett; **Levy Co.:** 1♂: St. Rd. 24 west of Archer, 29.50446, −82.56953, on *Serenoa repens*, 12-VIII-2018, J. Hayden, E18-4294; 1 larva: Archer, 29.5045, −82.5699, 25-X-2018, *Serenoa repens*, J. Hayden, J. Awad, H. Rohrer; 2 larvae: same data except 31-XII-2018, J. Hayden; 1 larva: Levy Co.: Cedar Key, 29.2056, −83.0622, 31-III-2018, Serenoa repens, J. Hayden, J. Awad; **Marion Co.:** 1♂: Ocala Nat'l. Forest, 2–5-V-1979, insect flight trap, G.B. Fairchild; **Martin Co.:** 1♂: Jonathan Dickinson St. Pk. 8–10-VIII-1999, J.B. Heppner; **Orange Co.:** 1 larva: Lake Buena Vista, 27-III-1978, *Livistona chinensis*, F.L. Ware; **Putnam Co.:** 17♂: Welaka For. Cons. Sta., Welaka Site 5, slash pine-palmetto flatwoods, 28–31-VII-1986, J.B. Heppner; 1♂: same data, MGCL slide 3301; 1♂: same data, MGCL slide 5030 (wings); **Sarasota Co.:** 1♂: Myakka St. Park, 2–3-V-1986, H.D. Baggett; **St. Lucie Co.:** 3 larvae: White City, Savannahs Park, 22-III-1979, Sabal palmetto, D.H. Habeck; **Volusia Co.:** 1♂: Tomoka State Park, 22–25-V-2000, J.B. Heppner; **Wakulla Co.:** 1♂: Ochlockonee State Park, 22–24-IV-1991, J.B. Heppner.

**Host plants.** *Sabal palmetto, Serenoa repens,* and once on *Livistona chinensis*.

### *Homaledra octagonella* (Walsingham)

(Fig. 49)

**Material examined. USA: Florida: Alachua Co.:** 1 larva: Gainesville, 2832 NW 41st Place, 3-XI-2020, J. Hayden; **Indian River Co.:** 1♂: Vero Beach, SE 9 St. FMEL impoundment, 27.58701, −80.36875, 18-V-2012, UV, J.E. Hayden; **Marion Co.:** 1♂: Santos, MV light, 3-IV-1991, J.S. Kutis; 1♂: Santos, CR 328, 1 mi. E. of CR 475, MVL, 16-III-1991, J.S. Kutis, MGCL slide 4543; **Putnam Co.:** 1♂: Welaka For. Cons. Sta., Site 4, live oak xeric hammock, 17–21-III-1986, J.B. Heppner, MGCL slide 4542; 1♂: same data except 28–31-VII-1986; 1♂: Palatka, at MV/UV light, 28-III-1991, H.D. Baggett; **Volusia Co.:** 1♂: Blue Spring State Park, 31-III-1983, L.C. Dow.

**Remarks.** The general characters of the single available larva are consistent with most other *Homaledra* species: a submental pit is present, the V setae on T1–T3 are medioposterior of the close-set coxae, the A1 SD1 seta is hairlike (being short and curved), and the A9 D1 seta is anterior of D2. The larva bears a straight case with octagonal cross-section that appears to be made of frass pellets.

### Key to adult moths of *Homaledra* in Florida

1. Forewing with scattered black scales; male tergites II and III medially narrowed and pleural sex scales prominent . . . . . **2**
— Forewing without scattered black scales (with spots only on end of discal cell, anal fold, and termen); male tergites not narrow, pleural sex scales not prominent . . . . . **3**

2(1). Forewing color white; forewing length 4.5–5.0 mm; cornuti absent; corpus bursae evenly sack-shaped, with spiny signum about 1/3 from anterior end . . . . . ***H. octagonella* (Walsingham)**
— Forewing color beige; forewing length 6.0–8.0 mm; cornuti in a narrow arc; corpus bursae medially narrowed, with spiny signum in posterior chamber . . . . . ***H. howardi* Hayden, new species**

3(1). Forewing color orange with medial longitudinal silver streak and spot; male without cornuti (female not observed) . . . . . ***H. heptathalama* Busck**
— Forewing color beige; cornuti present . . . . . **4**

4(3). Forewing veins concolorous with rest of wing, not white; antennae shorter than wings; cornuti small and hairlike, in a diffuse zone; signum discrete and spinose . . . . . ***H. sabalella* (Chambers)**
— Forewing veins white; cornuti large and melanized; signum a diffuse field of granules . . . . . ***H. knudsoni* Hayden, new species**

# Discussion

Other species of *Homaledra* remain to be described from the Caribbean Region and Central America. Some of them may have been the causes of historical economic damage to palms in those regions. Wolcott (1923) cited *"H. sabulella"* [sic] in Puerto Rico as a pest of coconut palms and *Livistona*. This probably refers to the undescribed species collected by Abreu, which Howard supposed was conspecific with *H. howardi*. Martorell (1945) furthermore listed the mountain palm *Euterpe globosa* Gaertn. as a host of *H. sabalella* in Puerto Rico, with infestations occurring on the plants at high elevations in the Luquillo Mountains. That record could refer to a second undescribed *Homaledra* species that has been collected at light in those mountains, represented by specimens in

**Table 1.** Host plants and associated *Homaledra* species, considering only those from which larval or adult moth specimens were collected and examined. Table only indicates the presence of a species on a host, not frequency. Sources: Atlas of Florida Plants (AFP, Wunderlin et al. 2021) for native and naturalized species; Dr. P. Anderson for distributions of those not in the AFP. "South" refers approximately to the area from Palm Beach Co. to Monroe Co.

| **Host plant** | ***Homaledra* species** | **Distribution in Florida** |
|---|---|---|
| *Acoelorraphe wrightii* (Griseb. and H. Wendl.) H. Wendl. | *H. sabalella* | South; Tampa Bay |
| *Bismarckia nobilis* Hildebr. and H. Wendl. | *H. howardi* | South, occasional to North Central |
| *Butia capitata* (Mart.) Becc. | *H. knudsoni*, *H. sabalella* | Throughout |
| *Cocos nucifera* L. | *H. howardi*, *H. sabalella* | South |
| *Cocos* sp. | *H. sabalella* | — |
| *Copernicia alba* Morong | *H. sabalella* | South |
| *Corypha umbraculifera* L. | *H. howardi* | South |
| *Corypha* sp. | *H. howardi* | — |
| *Latania lontaroides* (Gaertn.) H.E. Moore | *H. howardi* | South |
| *Latania* sp. | *H. howardi* | — |
| *Livistona chinensis* (Jacq.) R. Br. ex Mart. | *H. heptathalama*, *H. howardi*, *H. knudsoni* | Peninsula |
| *Livistona nitida* Rodd | *H. sabalella* | Occasional in Peninsular FL |
| *Phoenix canariensis* H. Wildpret | *H. sabalella* | Peninsula |
| *Phoenix reclinata* Jacq. | *H. sabalella* | Southern Peninsula, coast |
| *Phoenix* sp. | *H. sabalella* | — |
| *Rhapidophyllum hystrix* (Pursh) H. Wendl. and Drude ex Drude | *H. sabalella* | Panhandle to Central FL |
| *Roystonea oleracea* (Jacq.) O.F. Cook | *H. sabalella* | South |
| *Sabal minor* (Jacq.) Pers. | *H. sabalella* | Panhandle to Lake Okeechobee |
| *Sabal palmetto* (Walter) Lodd. ex Schult. and Schult. f. | *H. heptathalama*, *H. howardi*, *H. knudsoni*, *H. sabalella* | Throughout |
| *Sabal* sp. | *H. howardi* | — |
| *Serenoa repens* (W. Bartram) Small | *H. heptathalama*, *H. howardi*, *H. knudsoni*, *H. sabalella* | Throughout |
| *Syagrus romanzoffiana* (Cham.) Glassman | *H. sabalella* | Tampa Bay and southward |
| *Thrinax* sp. | *H. howardi*, *H. sabalella* | — |
| *Washingtonia filifera* (Linden ex André) H. Wendl. | *H. sabalella* | Peninsula |
| *Washingtonia robusta* H. Wendl. | *H. howardi*, *H. knudsoni*, *H. sabalella* | South, and Tampa Bay |
| *Zombia antillarum* (Descourt) L.H. Bailey | *H. howardi* | South |

the FSCA and MGCL, but that is speculative. Fieldwork and rearing will be needed to support that hypothesis. Unfortunately, historical specimens of *Homaledra* are missing from the Insect Collection of the University of Puerto Rico at Mayagüez (UPRM; Edda Martinez, pers. comm. 2016). Russo (1927) recorded damage to palms in the Dominican Republic, and photographs of damage in Schmutterer (1990) are consistent with a species that is not *H. sabalella*. Studying coconut trees in in Guerrero, Mexico, Noriega et al. (1991) found an association between fungal infection of foliage and an unidentified *Homaledra* species. It is quite likely that some of these populations in the Greater Antilles and Mexico are referrable to the species described above, but positive identification will depend on examination of imaginal specimens or COI sequencing.

Published host records must be considered with caution. Both the moth species and the host palm species may be misidentified. The various species of *Homaledra* are more frequently collected on some hosts than on others. This may be due to intrinsic host preferences of the larvae, the relative abundance of the hosts, or to the biases and limitations of the collectors. Table 1 notes only the presence of a species on a host, and it should not be taken to imply that a species occurs on all hosts with equal frequency. Many of the older larval collection records come from FDACS-DPI plant inspectors, whose primary duty is to inspect stock for propagation and sale at plant nurseries. The low, accessible height of *Latania* foliage could explain the earliest records of *H. howardi*; taller palms need special equipment to sample (Howard et al. 2001). Assertions about host preference would be better assessed by experimental host-choice tests or at least by field surveys with random sampling.

It remains to be explained why *H. howardi* is currently restricted to southern Florida, despite having been present for more than four decades, whereas *H. knudsoni* has become established across a wider area of the state apparently in a third of that time. *Homaledra knudsoni* is most commonly found on *Sabal palmetto*, and cabbage palms are ubiquitous in Florida. However, *H. howardi* has also been reared on *S. palmetto* plus a wider range of ornamental palms, so its current restriction to South Florida cannot be explained by host plants alone.

Natural enemies are nearly absent from rearings of *H. howardi* and *H. knudsoni*. Predatory insects are not uncommon in nests of *H. sabalella*, and some of the species listed by Creighton (1937) were found in nests collected in the course of this study, such as *Plochionus amandus* Newman (Carabidae) and *Horismenus ignotus* Burks (Eulophidae). In contrast, no predatory insects were found associated with *H. howardi*. Only one species was reared from a nest of *H. knudsoni*, an undetermined microgastrine braconid, but since it was not directly observed, it is not certain that *H. knudsoni* was the host rather than an inquiline arthropod. The absence of natural enemies may partly explain the invasive success of these species. A report of a larger preliminary survey by Howard (USDA 2002) indicates that he did rear natural enemies from *H. howardi*, although the specimens could not be located. Replication of Howard's survey and additional work in the predicted native ranges of the species—Hispaniola and Mexico—may yield more definite answers about the kinds and frequency of predators.

## Acknowledgments

Many years of work by many people have enabled these results. John B. Heppner (FLMNH, formerly DPI) initiated the research on *H. howardi* and obtained specimens from Puerto Rico. Dr. Robin Giblin-Davis (UF FLREC) carefully saved Howard's reared specimens after the latter retired and his office was slated for renovation, and he made them available for this publication. Jim Vargo, with his assiduous collecting and keen eye for differences, first alerted me to the distinctiveness of *H. knudsoni*. Mark Metz (USDA SEL) curated Chambers's type material of *H. sabalella*, made them available for study in 2019, and goaded me to investigate by posing tough questions about their ecology and distribution. He and David Adamski also noted the uniqueness of the phallus sclerite. Heather Rohrer (FLMNH) reared larvae for many of the overwhelmingly numerous submitted samples, and she effectively replicated Creighton's and Cronin's rearing methods for *H. sabalella*, which had not been attempted for about ninety years. Several Florida Museum volunteers and staff helped collect samples, including Tedd Greenwald, Mary Ellen Flowers, Jon Bremer, and Deborah Matthews-Lott. Numerous personnel in the DPI Bureau of Plant Inspection (see Material Examined) collected samples from across the State; special thanks to Leroy Whilby, Jason Stanley, and Bradley Danner for putting out an alert for skeletonizers that coincided with a statewide survey of palm diseases. Drs. Elijah Talamas (DPI) and David Serrano (Broward College) ran malaise traps that yielded northern and southern records of *H. knudsoni*, and staff at the Coral Gables USDA Southern

Horticultural Research Station ran the suction trap, which always yields *H. howardi*. DPI Molecular Diagnosticians Pratibha Srivastava and Matthew Moore helpfully barcoded specimens, which not only provided the COI data, but also was the only way to identify immature stages before the chaetotaxy was understood. Several donors to the McGuire Center for Lepidoptera and Biodiversity provided funds for the Leica DM6 B microscope camera. Marc Epstein (CDFA) loaned specimens from San Diego. Andy Boring (USDA PPQ) and Jessica Awad (UF) identified the Hymenoptera parasitoids. Lauri Kaila (U. Helsinki) commented about the morphology of *Syringopais*. Jeff Eby (FDACS-DPI) and Rosina Taveras Macarrulla (Universidad Autónoma de Santo Domingo) provided literature. Dr. Patti Anderson (FDACS-DPI) kindly reviewed the manuscript for botanical and typographical errors, and she supplied distributions of ornamental palms that are not naturalized in the state. Mark Metz, Sora Kim (Seoul National University), and Paul Skelley (FDACS-DPI) reviewed the manuscript and made many very helpful suggestions and caveats. This publication was supported by the Florida Department of Agriculture and Consumer Services – Division of Plant Industry.

## Literature Cited

**Baldizzone G, van der Wolf H, Landry J-F. 2006.** World catalogue of insects, vol. 8: Coleophoridae, Coleophorinae (Lepidoptera). Apollo Books; Stenstrup. 215 p.

**Busck A. 1900.** New species of moths of the superfamily Tineina from Florida. Proceedings of the United States National Museum 23(1208): 225–254, 1 pl.

**Carter DJ. 1998 [1999].** Key to families: larvae. p. 31–39. In: Carter DJ, Kristensen NP. Classification and keys to higher taxa. Ch. 3, p. 27–40. In: Kristensen NP (ed.). Handbook of zoology. Vol. IV (Arthropoda: Insecta), Part 35, Lepidoptera, moths and butterflies. Vol. 1: Evolution, systematics, and biogeography. Walter de Gruyter; Berlin / New York. x+491 p.

**Chambers VT. 1880.** Descriptions of some new Tineina, with notes on a few old species. Journal of the Cincinnati Society of Natural History 2(4): 179–194.

**Clark K, Karsch-Mizrachi I, Lipman DJ, Ostell J, Sayers EW. 2016.** GenBank. Nucleic Acids Research 44: D67–D72. Available at https://www.ncbi.nlm.nih.gov/genbank/ (Last accessed 1 Feb. 2021.)

**Clarke JFG. 1965.** Catalogue of the type species of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick. Vol. 5. Trustees of The British Museum (Natural History); London. 581 p.

**Creighton JT. 1929.** The biology and life history of the palm-leaf skeletonizer (palm-leaf miner) *Homaledra sabalella* (Chambers) an insect pest of the palms. Unpublished Masters' Thesis. University of Florida; Gainesville, FL, USA. 129 p. + 14 pl.

**Creighton JT. 1937.** *Homaledra sabalella* Chambers, the major pest of palms in Florida. Journal of Economic Entomology 30(4): 590–595.

**Cronin JT. 2011.** Spatial ecology of the palm-leaf skeletonizer, *Homaledra sabelella* [sic] (Lepidoptera: Coleophoridae). PLoS ONE 6(7): 1–9.

**Eiseman C. 2008.** Species *Homaledra octagonella* – Octagonal Casemaker Moth. BugGuide, hosted by Iowa State University Department of Entomology. Available at https://bugguide.net/node/view/229786 (Last accessed 24 Jan. 2021.)

**Hayden JE. 2019 [2018].** The palm leaf skeletonizer situation in Florida. Southern Lepidopterists' News 40(4): 275–281.

**Hebert PD, Penton EH, Burns JM, Janzen DH, Hallwachs W. 2004.** Ten species in one: DNA barcoding reveals cryptic species in the neotropical skipper butterfly *Astraptes fulgerator*. Proceedings of the National Academy of Sciences 101: 14812–14817.

**Heikkilä M, Mutanen M, Kekkonen M, Kaila L. 2014.** Morphology reinforces proposed molecular phylogenetic affinities: a revised classification for Gelechioidea. Cladistics 30: 563–589.

**Hoare R, Dugdale J, Watts C. 2006.** The world's thinnest caterpillar? A new genus and species of Batrachedridae (Lepidoptera) from *Sporadanthus ferrugineus* (Restionaceae), a threatened New Zealand plant. Invertebrate Systematics 20: 571–583.

**Hodges RW. 1983.** Batrachedrinae. p. 17. In: Check list of the Lepidoptera of America north of Mexico including Greenland. Hodges RW et al. (eds.). E.W. Classey and The Wedge Entomological Research Foundation; London. xxiv+284 p.

**Hodges RW. 1997.** A new agonoxenine moth damaging *Araucaria araucana* needles in western Argentina and notes on the Neotropical agonoxenine fauna (Lepidoptera: Gelechioidea: Elachistidae). Proceedings of the Entomological Society of Washington 99(2): 267–278.

**Hodges RW. 1998 [1999].** The Gelechioidea. p. 131–158. In: Kristensen NP (ed.). Handbook of zoology. Vol. IV (Arthropoda: Insecta), Part 35 (Lepidoptera, moths and butterflies), Vol. 1: Evolution, systematics, and biogeography. Walter de Gruyter; Berlin / New York. x+491 p.

**Howard FW. 1996.** Host preferences of the palm leaf skeletonizer. Tropicline (UF IFAS Fort Lauderdale) 9(1): 4. Available at http://ufdc.ufl.edu/UF00089450/00011/4x (Last accessed 30 Nov. 2020.)

**Howard FW, Abreu E. 2007.** The palm leaf skeletonizer, *Homaledra sabalella* (Lepidoptera: Coleophoridae): status and potential pest management options. Proceedings of the Florida State Horticultural Society 120: 356–359.

**Howard FW, Moore D, Giblin-Davis RM, Abad RG. 2001.** Insects on palms. CABI Publishing; Wallingford, UK / New York. xiv+400 p.

**Kaila L, Mutanen M, Nyman T. 2011.** Phylogeny of the mega-diverse Gelechioidea (Lepidoptera): adaptations and determinants of success. Molecular Phylogenetics and Evolution 61: 801–809.

**Kemal M, Koçak AÖ. 2015.** *Syringopais temperatella* (Led.) in South Turkey (Lepidoptera, Gelechioidea). Cesa News (Ankara) 106: 5–12.

**Knudson E, Bordelon C. 2008.** Illustrated checklist of the Lepidoptera of the Lower Rio Grande Valley Texas. Vol. 3C: Micro-moths and geometroids. Texas Lepidoptera Survey Publication 9c; Houston, TX, USA. 30 p.

**Kozub D, Khmelik V, Shavopal J, Chentsov V, Yatsenko S, Litovchenko B, Starikh V. 2000.** Helicon Focus v. 6.7.1 Pro. Helicon Soft Ltd. Available at www.heliconsoft.com (Last accessed 7 Feb. 2021.)

**Kristensen NP. 2003.** Skeleton and muscles: adults. p. 39–131. In: Kristensen NP (ed.). Handbook of zoology. Vol. IV (Arthropoda: Insecta), part 36 (Lepidoptera: moths and butterflies), Vol. 2: Morphology, physiology, and development. Walter de Gruyter; Berlin / New York. xii+564 p.

**Martorell LF. 1945.** A survey of the forest insects of Puerto Rico. Journal of Agriculture of the University of Puerto Rico 29(3): 1–608.

**Noriega CDH, Becerra LN, Hernández RF. 1991.** Estudio preliminar de enfermidades del cocotero en la Costa de Guerrero, México. Revista Mexicana de Fitopatología 9(2): 84–93.

**Penrose D. 2001.** Palm leafskeletonizer [*sic*], *Homaledra sabalella* (Chambers). CDFA Detection Advisory PD02-01. 1 p.

**Ratnasingham S, Hebert PDN. 2007.** BOLD: The Barcode of Life Data System (www.barcodinglife.org). Molecular Ecology Notes 7: 355–364.

**Ratnasingham S, Hebert PDN. 2013.** A DNA-based registry for all animal species: the Barcode Index Number (BIN) System. PloS ONE 8(8): e66213. https://doi.org/10.1371/journal.pone.0066213

**Robinson GS. 1976.** The preparation of slides of Lepidoptera genitalia with special reference to the microlepidoptera. Entomologist's Gazette 27: 127–132.

**Russo G. 1927.** Dominican Republic: chief insects harmful to crops. International Bulletin of Plant Protection 1(7): 108–110.

**Schmutterer H. 1990.** Crop Pests in the Caribbean: with particular reference to the Dominican Republic. Cruz RR, Cicero JSJ, Koch CK (transl.). Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ); Eschborn. 640 p.

**Shorthouse DP. 2010.** SimpleMappr, an online tool to produce publication-quality point maps. Available at https://www.simplemappr.net (Last accessed 26 July 2020.)

**USDA - Research, Education and Economics Information System. 2002.** Identification, bionomics, and control of palm leaf skeletonizers, *Homaledra* spp. Grant No.2002-34135-12467. Available at https://portal.nifa.usda.gov/web/crisprojectpages/0194602-identification-bionomics-and-control-of-palm-leaf-skeletonizers-homaledra-spp.html (Last accessed 2 Aug. 2020.)

**White M. 2006.** Palm Leaf Skeletonizer. Bugguide, hosted by Iowa State University Department of Entomology. Available at https://bugguide.net/node/view/88989 (Last accessed 25 July 2020.)

**Wolcott GN. 1923.** Insectae Portoricensis. A preliminary annotated check-list of the insects of Porto Rico, with descriptions of some new species. Journal of the Department of Agriculture of Porto Rico 7(1): 1–312.

**Wunderlin RP, Hansen BF, Franck AR, Essig FB. 2021.** Atlas of Florida Plants. Institute for Systematic Botany, University of South Florida, Tampa. Available at http://florida.plantatlas.usf.edu/ (Last accessed 31 Jan. 2021.)

**Yefremova Z, Kravchenko V, Meltzer N. 2017.** The East-Mediterranean cereal leaf miner *Syringopais temperatella* Lederer and its larval parasitoids in Israel. Phytoparasitica 45: 707–713.

**Received February 13, 2021; accepted March 7, 2021.**
**Review editor David Plotkin.**